U. S. DEPARTMENT OF AGRICULTURE

WORK AND EXPENDITURES OF THE AGRICULTURAL EXPERIMENT STATIONS, 1918

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STATES RELATIONS SERVICE.

A. C. True, Director.

OFFICE OF EXPERIMENT STATIONS.

E. W. Allen, Chief.

RELATIONS WITH INSTITUTIONS FOR AGRICULTURAL RESEARCH.

Supervision of Work and Expenditures of the State Experiment Stations Under Federal Appropriations.

E. W. Allen, E. R. Flint, J. I. Schulte, W. H. Evans, W. H. Beal.

Experiment Station Record.

E. W. Allen, Ph. D., editor; H. L. Knight, B. S., associate editor; Sybil L. Smith, A. B., M. A., agricultural chemistry and agrotechny; W. H. Beal, A. B., M. E., and R. W. Trullinger, B. S. C. E., meteorology, soils, and fertilizers; W. H. Evans, Ph. D., and W. E. Boyd, Ph. B., agricultural botany, bacteriology and plant pathology; J. D. Luckett, M. S., and J. I. Schulte, B. Agr., field crops; E. J. Glasson, B. S. A., horticulture and forestry; W. A. Hooker, B. S., D. V. M., economic zoology and entomology; C. F. Langworthy, Ph. D., D. Sc., and Sybil L. Smith, B. A., M. A., foods and human nutrition; F. J. Kelley, B. S., animal husbandry, dairying, and dairy farming; W. A. Hooker, B. S., D. V. M., and Sybil L. Smith, B. A., M. A., veterinary medicine; R. W. Trullinger, B. S. C. E., rural engineering; Eugene Merritt, A. B., and Louise Marbut, A. B., rural economics; A. Dille, A. B., and Marie T. Spethmann, agricultural education; Amelia B. Deans, indexing; William Henry, proof reading.

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W. H. Evans, Ph. D., Chief.

Alaska Experiment Stations.

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Hawaii Experiment Station.

J. M. Westgate, M. S., agronomist in charge, Honolulu; J. E. Higgins, horticulturist; F. G. Krauss, superintendent of extension work, Haiku; R. A. Goff, B. S., extension director, Hilo; C. W. Carpenter, M. S., plant pathologist; W. Macfarlane, Ph. D., specialist in soil fertility investigations; J. H. Cowan, assistant in horticulture; H. L. Chung, B. S., assistant in agronomy; K. A. Ching, B. S., assistant chemist.

Porto Rico Experiment Station.

D. W. May, M. Agr., agronomist in charge, Mayaguez; T. B. McClelland, A. B., horticulturist; W. V. Tower, plant pathologist; L. G. Willis, B. S., chemist; J. O. Carrero, B. S., Ch. E., assistant chemist; W. P. Snyder, B. S., assistant in plant breeding; J. P. Griffith, B. S., assistant horticulturist; H. C. Henricksen, B. Agr., specialist in farm management, San Juan; W. A. Mace, B. A., agricultural technologist.

Virgin Islands Experiment Station.

Longfield Smith, Ph. D., agronomist in charge, St. Croix; C. E. Wilson, M. A., entomologist.

LETTER OF TRANSMITTAL.

U. S. Department of Agriculture,
States Relations Service,
Washington, D. C., November 7, 1919.

Sir: I have the honor to transmit herewith a report on the agricultural experiment stations in the United States for the fiscal year ended June 30, 1918, and on the work of the Department of Agriculture in relation thereto. This is a part of a report prepared in accordance with the following provision of the act of Congress of March 4, 1915, entitled "An act making appropriations for the Department of Agriculture for the fiscal year ending June thirtieth, nineteen hundred and sixteen":

That hereafter there be prepared by the Department of Agriculture an annual report on the work and expenditures of the agricultural experiment stations established under the act of Congress of March second, eighteen hundred and eighty-seven (Twenty-fourth Statutes at Large, page four hundred and forty), on the work and expenditures of the Department of Agriculture in connection therewith, and on the cooperative agricultural extension work and expenditures of the Department of Agriculture and of agricultural colleges under the act of May eighth, nineteen hundred and fourteen, entitled "An act to provide for cooperative agricultural extension work between the agricultural colleges in the several States receiving the benefits of an act of Congress approved July second, eighteen hundred and sixty-two, and of acts supplementary thereto, and the United States Department of Agriculture"; and that there be printed annually eight thousand copies of said report, of which one thousand copies shall be for the use of the Senate, two thousand copies for the use of the House of Representatives, and five thousand copies for the use of the Department of Agriculture (38 Stat. L., p. 1110).

This report embodies all the information heretofore submitted in compliance with the provisions of 34 Statutes at Large, page 64, section 5.

Very respectfully,

A. C. True, *Director.*

Hon. D. F. Houston,
Secretary of Agriculture.

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WORK AND EXPENDITURES OF THE AGRICULTURAL EXPERIMENT STATIONS, 1918.

By E. W. Allen, E. R. Flint, and J. I. Schulte.

This report, prepared by the Office of Experiment Stations, States Relations Service, deals with the activities of the experiment stations and the use made of the funds granted by the Federal Government under the Hatch and Adams Acts. It is based on personal visits to each of the State stations by representatives of the Office of Experiment Stations, the publications and financial reports of the stations, and certain other data supplied by them on request.

RELATIONS OF THE OFFICE OF EXPERIMENT STATIONS WITH THE EXPERIMENT STATIONS.

During the year the Office of Experiment Stations maintained the usual close relations with the stations in the States, and there was more than the ordinary opportunity for suggestion and assistance. This grew out of the many changes in station personnel, questions relating to the policy of the stations in war time, and their relations to other agencies.

The question of modification of the activities of the stations to meet the unusual conditions early came up for consideration. Adaptation to the existing situation and needs was a matter which practically every station had to meet. It was necessary, therefore, to define the policy as far as it affected the Federal funds. While maintaining the general purpose and limitations of these funds, and the necessity for using them broadly for experimental inquiry and for interpreting and making readily available the results, unusual liberality was exercised in the doing of things which contributed to the general welfare but did not involve the stations abandoning their primary function and taking up the work of another agency. It was unnecessary for the experiment station forces to invade the field of the extension service, with its increased army of workers. The stations had a more important function to prepare and make available to this service and to the public generally the teachings of investigation and their special applications to the time and the locality.

The stations were cautioned to preserve their organization and their identity, but at the same time to relate themselves to the needs of the situation. They were advised to draw close to practical questions and

to the forces which were acting as direct advisors to the farmers, and to place their special facilities and resources at the disposal of the State and the Nation, not forgetting that investigation was their primary function. In other words, they were cautioned to continue to function as experiment stations under a liberal interpretation, and not to forget even temporarily that they were the main reliance for investigation upon which the various other agricultural agencies and movements depended.

In the adaptation of the stations to the special conditions the desirability became apparent of some measure of cooperation, coordination, a closer union of activity, and a better understanding of what each was doing, in order to economize time and facilities to the utmost and make progress more secure. The Office of Experiment Stations promoted this movement and in a number of instances served as a central clearing house for it. Under the stress of the period more definite progress was made in this direction than in all the past, and it is believed that the cooperative idea as distinguished from purely independent, individual effort has taken firm hold. Naturally such joint or related action has its limitations in investigation, and in advanced research individual initiative and ability must be stimulated and relied upon for progress; but there are many types of activity in which mass effort or coordinated action may be more productive and more logical. It is an expression of a present tendency in science.

Relations with the Georgia Experiment Station were suspended during the year, since the station did not share in the Federal funds. As a culmination of long-continued effort to bring this station into alignment with other stations established under the Hatch Act, and the unsatisfactory conditions which developed in the station administration, the department declined to issue a certificate for the Georgia station and reported the matter to Congress through the President. That body ultimately assumed the responsibility for the maintenance of the station as a separate institution, independent of the State college of agriculture and located in another section of the State. It authorized the Secretary of Agriculture to continue the payment of the Federal funds to the station as organized, but the action did not become effective until after the close of the fiscal year.

Insular stations.—The Office of Experiment Stations continued to exercise general supervision over the stations in the insular possessions which derive their support from direct Federal appropriation to the Department of Agriculture. These stations are located in Alaska, Hawaii, Porto Rico, and Guam. While each of them has its special administrative officer, close contact is maintained through correspondence and the approval of current accounts for expenditures. Appointments are passed upon before they are made, and manuscript is submitted for approval before publication. The year

was an unusually active one at these stations, which took a leading part in measures for larger or more adequate local food production.

Visitation of the stations.—The examination of the stations was carried on as in the past, each State station receiving Federal funds being visited by a representative of the office at least once during the year.

In connection with the annual examination or visitation of the stations a detailed review was made of the work in progress and accomplished, and of the use made of the Federal funds, and conferences were had with administrative officers and members of the staff on many matters relating to the organization and conduct of the station work. The personal visits were supplemented by extensive correspondence with the stations throughout the year, the approval of new projects taken up under the Adams fund, and the approval of the annual programs for investigations under that fund. At the close of the year the financial reports of the stations were presented for approval.

The examination was participated in by five members of the office force—the chief (E. W. Allen), W. H. Evans, W. H. Beal, E. R. Flint, and J. I. Schulte.

THE EXPERIMENT STATIONS IN WAR TIME.

The report for the year 1918 deals with a period attended by unusual conditions, which inevitably affected the work and the activities of the experiment stations in a very vital manner. The war, with the special burden it laid upon this country to maintain the highest possible production of food, emphasized the importance of intelligent, effective methods and practices in agriculture to save labor and its products, and to raise still higher the productive capacity of the individual as well as that of the available agricultural land.

These efforts to secure more efficient production rested directly upon the fund of information resulting from experimentation, especially during the past 25 or 30 years. The work of the stations had prepared for more efficient production and made it possible. In applying this information in the emergency the source of the knowledge was not inquired into, for much of it had been gradually woven into better farm practice and had become a part of the equipment of leading farmers and especially their advisers. But in a very large measure it could be traced back to the steady, unostentatious work which the experiment stations and the Federal Department of Agriculture have been engaged in for many years, reaching every section of the country and covering not only broad general principles of agricultural practice but an endless variety of local and regional questions. The occasion gave unusual opportunity for putting the

results of these findings into practical operations, and demonstrated as nothing ever had before the value of these institutions as an element of the national strength.

The stations are a part of the reserve forces built up in this country which are available for special service in an emergency, and in this case their activity covered a very wide range. They were affected by the special demands of the time for leadership and for putting into operation and managing new enterprises. The planning of the great production campaigns and the requirements of the army of advisers in close contact with the farmers made large demands upon the stations. The conditions growing out of National and State food control and conservation brought another requirement for service in unusual lines; and finally the draft and other demands for technical workers depleted the station ranks to a very noticeable extent.

The year was such an abnormal one in many respects that it has seemed advisable to depart from the usual form of report, dealing with the stations individually, and to treat them and their work as a group. In this way it is thought that a better general view may be had of the operations of the stations in this critical period and the effects of war-time conditions upon them.

Response of the stations.—While the working staff of the experiment stations was seriously depleted in many instances, the effect of this was to stimulate those remaining to extraordinary effort, so that the year was one of unusual activity. At the outset there was naturally a certain amount of restlessness among station workers arising from distracting influences and the desire to take a more direct and active part in war work. As time went on, however, and various enterprises came to be organized, calls upon station men for special services and information brought them into more direct and evident relations with the food campaign and various national movements, and made clearer the importance of their position. There was large demand for information bearing especially upon means of increasing production, and also for such as would be helpful in the operations of war, the feeding and care of the men, and the training and treatment of animals. Special attention was given by the stations to compiling and publishing in popular form the results of their work which were applicable to the situation.

The station forces worked in close cooperation with the extension forces, and in many instances the station workers entered the extension field for special services or related their activities to the general movement. They served as leaders in a great variety of local, State, and national movements organized to promote production and conservation. This was especially the case with State production cam-

paigns, war agricultural committees, and the enforcement of food control.

The research work of the stations was interrupted to some extent by the greatly increased call for information and special services. As a rule, however, the research problems of the stations were rarely abandoned or greatly changed except to direct them into channels having a more immediate bearing on problems connected with war conditions. To this end there was a quite general readjustment of the working programs. Project lists were revised with a view to stressing those features which were particularly timely. New topics were taken up as suggested by unusual conditions, and in general the operations were adapted to the immediate need for guidance and direction, the leading idea being to secure the largest feasible production with a corresponding minimized loss.

The stations' contribution.—Varied as were the adaptations and special services of the stations, their greatest contribution was the fund of readily available information they had developed and the larger intelligence and understanding in agricultural matters which it had engendered. Their results had reached the farming people in a very large degree, sometimes directly, often indirectly, and through channels which had become more numerous year by year.

In how large a measure the teachings of experiment are responsible for the success of the recent food-production campaigns may be illustrated by the efforts to meet the world's deficiency in bread. This is seen first of all in the plan of campaign.

At one time there might have been a tendency, when the supply of a great staple commodity was in danger, to encourage farmers to grow it to the utmost extent without due regard to other agricultural considerations. A conspicuous feature of the war-production programs and campaigns, however, was an intelligent consideration of the welfare of agriculture as a whole. These programs and campaigns recognized that the more scientifically planned systems of farming now take account of the well-balanced production of food for both man and beast, the maintenance of fertility of the land, the economy and adjustment of labor, and many other conditions which should not be unduly disturbed. They were therefore allowed for in making the plans, allotting the areas, and conducting the campaigns. This made the undertaking something more than a patriotic movement, for it was guided by an intelligent conception of the requirements of the situation. The latter rested, of course, in considerable measure on accumulated experience, but this had been weighed and tested and was correlated with the results of thoroughgoing fundamental investigation.

The securing of a largely increased wheat crop was not merely the result of seeding a larger area to that crop. It was not simply a

question of land and machinery and labor, vital as these were. Neither did the degree of success attained follow simply because people had been growing wheat for generations and had thus become experienced in its production, but because the practice had been steadily improved through experiment and investigation, and the greater efficiency thus developed was ready for wider application when an emergency came.

The question of varieties, their adaptation to localities, the value of improved sorts, the relative safety of spring and winter grain in different sections, the treatment of seed for smut, protection against rust, the amount to be sown to the acre, the time when it should be planted in different localities to avoid the Hessian fly, the advantage of thorough seed-bed preparation, the kind of fertilizers for certain sections—all these things had been worked out to a practical point through years of patient study and experiment. After the crop was harvested there was the question of protecting it from loss in storage and finally its conservation by the use of substitutes and admixtures. It is impossible to estimate how much this knowledge counted for. But if wheat growing had not been placed on this efficient basis by the practical use of the results of investigation the demand for increased wheat production could not have been met as it was. No amount of stimulation could have accomplished such a result.

Next to bread the greatest need and the most urgent call was for animal products, for which this country was very largely looked to. Pork production constitutes more than half of all the meat production in the United States, and such large increases were made that the emergency was fully met, the export of pork products being nearly doubled. This again is an indirect result of investigation which has in many respects revolutionized the practice of hog raising. There is hardly a phase of pork production that has not been subjected to extensive and long-continued experiments, covering the type of hog, the value of different feeds, the place of supplements in addition to corn, the use of hog pastures to supply a succession of feed, the size at which the pig should be profitably marketed, and many other practical and economic points. Disease had become the great bane of hog production on a large scale, but the long and searching investigations, resulting in successful methods of inoculation, enabled extensive campaigns to be conducted in the interest of greater security. The organization and instruction of pig clubs was an effective means of extending pork production. In these clubs the fund of information resulting from experiment found especially wide application.

No new crop or line of production can be suggested for a locality without at once raising the questions of how and when and why. In such cases the importance of experimental inquiry is especially

evident. This is illustrated by the case of the grain sorghums, soy bean, velvet bean, peanuts, and many other crops. The extension of the culture of the grain sorghums in the regions to which they are particularly adapted is a direct result of years of experiment in which different kinds were tested as to their adaptation to localities; were improved as to yield, drought resistance, and other qualities; their culture studied; their feeding value determined; and their utilization as food developed. They are not native to this country but are introduced species, and without this background of experiment there is little reason to believe that farmers or seedsmen would have introduced them and given them an extended and important place in the agriculture of the country, and the extension forces would not have had the basis for advising their wider culture.

The same is true of other crops, like many introduced forage plants, the adaptation of alfalfa to various localities and conditions, the very great extension of the range of successful corn growing and of dry-farming crops and methods.

Under the inspiration of the station work the preservation of feed in silos has become nation wide and has had an important bearing on systems of farming. Almost from the construction of the first silos for experimental purposes in this country, in 1881, an uninterrupted chain of experiments and intensive investigations has been carried on, which has resulted in the development of an efficient and safe system of preserving green feeds, resulting in a large increase in the feed production per acre. The American stations have led the way in this development, concerning themselves with every phase of the theory and practice of silo building, silage production, its value as feed for different classes of live stock, and its economic importance.

Successful production has become more and more a contest with disease and pests. The development of successful methods of coping with these outbreaks of diseases of plants and animals and injurious insects furnishes a brilliant chapter in the record of investigation. These studies, intensive and thoroughgoing in character, have led to enormous savings of products and have contributed to greater security in production.

These are only a few of the many practical examples that might be cited, but they indicate how largely dependent agricultural development and teaching have been on the results of investigation; and they point as well to the real source of success in extension teaching. The place of the experiment station in agricultural advancement, present and future, should be fully understood; and the requirements of the experiment stations to enable them to keep pace with the growth of means of dissemination and the hunger for knowledge should be recognized in adequate support.

MAIN LINES OF EXPERIMENTAL INQUIRY AT THE STATIONS.

In general, the work of the experiment stations has been along various lines of agronomy, animal husbandry, dairying, horticulture, plant pathology, entomology, and veterinary science, modified somewhat by the demands of different sections of the country. When this country entered the war these lines of activity were not abandoned, but they were intensified and directed especially to the emergency needs for greater food production and conservation. Special inquiries that war conditions called for were also taken up by many stations in addition to their regular lines of investigation. The following brief enumeration of some of these lines of investigation may serve to illustrate the wide range and ramifications of the work:

Agricultural chemistry.—Chemistry naturally enters more or less into a large number of the projects under investigation. Among the more strictly agricultural chemical inquiries may be mentioned studies of the organic matter in soils; the occurrence of phytin phosphorus in plant products and the function of organic phosphorus compounds in feeding stuffs for swine; the fixation of phosphoric acid in soils; the relation of phosphorus in the soil and in the crop, especially in wheat; and of the chemical composition of certain crops to phosphorus deficiencies in the soil. An important investigation which arose out of emergency conditions and was conducted cooperatively by a number of stations, was the study of methods of converting raw phosphate rock into an available form, by composting with sulphur and other materials. Other chemical subjects investigated included the relation of soil and fertilizer constituents to plant growth, the magnesium and sulphur nutrition of plants, the proximate constituents of plants and the requirements of plants for lime and magnesia, the decomposition of calcium and magnesium carbonates in soils and their influence in conserving soil sulphur, and studies of the limestone deposits in the various States.

Detailed chemical studies were conducted on the form of nitrogen in the nodules of legumes, the effect of pressure on enzyms, the composition of butter fat, Sudan grass, grain sorghums, and the apple; the process of silage making from legumes, the gluten colloids of wheat, the poisonous principle of the cotton seed, and food decomposition and poisoning. Studies relating to the methods of preserving food included the home canning of horticultural products, the drying of fruits and vegetables, and the curing of meats.

Other chemical studies dealt with improved methods of clarifying sugar cane juice, particularly with the use of decolorizing vegetable carbons; the deterioration in storage and losses in sugar manufacture due to bacteria, yeasts, and filamentous fungi; the elaboration

of maple sugar, with the starch and sugar content of maple leaves and wood; prune ripening; and the isolation of citric acid from milk.

Meteorology.—Meteorological observations were made at many of the stations, for supplying data for experiments in progress. At one station an attempt is being made to determine a temperature law in crop production. Various studies on the influence of meteorological factors, singly and combined, upon crop production are under way.

Soils.—Soil studies naturally constituted a prominent part of the work of many of the stations. These were along various lines, notably of soil bacteriology, acidity, fertility, and management; soil constituents, especially the nitrogen content of soils; and soil physics and soil surveys.

Soil bacteriological investigations included studies in nitrification and the conditions which affect it, sulfofication in relation to ammonification and nitrification, nitrogen fixation, especially the carbonaceous food requirements of the organisms, bacterial changes in soils due to different methods of treatment, effect of green manure on the soil bacterial flora, and factors influencing bacterial activity in soils. The relation of organic matter to the bacterial content, their mutual relation to productive capacity of the soil, and the relation between the bacterial flora and the composition of the soil were also studied. Other topics of investigation were the effect of organic matter on the longevity of *Bacillus radicicola*, the bacterial decomposition of organic matter and manures, soil inoculation for legumes, influence of soil treatment on the phosphorus content and availability, and the nitrogen cycle in acid soils.

Soil fertility studies were directed toward methods of maintaining and increasing productive capacity, including such subjects as the influence of rotations on soil fertility and methods of maintaining fertility by this means and by the use of commercial fertilizers, manures, and green manuring crops, and the effects of fertilizers and crops on soils. Some stations made special studies of the infertile soils of their States and methods of improving these, also of the potential fertility of the soils. Improved methods of soil management are under investigation, the methods of draining and cropping peat and muck lands, the decomposition of organic matter, and the availability of the nitrogen in such soils.

Soil acidity received much attention, including the effects of liming on the assimilation of nitrogen by crops and the action of lime in the decomposition of organic matter in soils. Investigations on the composition and constituents of the soil included studies of the effects of exhaustive cropping on the chemical composition, the availability and utilization of plant nutrients in soils under different methods of treat-

ment, the action of soil alkalis, and the treatment of alkali soils with sulphuric acid. The relation of sulfofication and nitrification to the phosphorus in soils, sulphur in relation to soils and crops, the effects and interreactions of lime and organic matter on rock and acid phosphates in soils, the rôle of manganese in soil fertility, and the availability of potash in subsoils were other important subjects of investigation.

Projects on the nitrogen in soils included studies of the effects of green manures and of bacterial action; nitrate production in soils, its development and control; the effect of electrical stimulation on nitrogen fixation; and the accumulation of nitrogen and carbon in soils under different systems of management.

Work in soil physics included studies of soil moisture constants, water percolation, evaporation, erosion, and run-off; the availability and conservation of soil waters; the relation of soil moisture to crops; moisture as affected by cultural practices; the composition and variation of the soil solution; and the rate of solubility of soils under different treatments and conditions. A study was made of the absorption of solutes, with particular reference to balanced solutions, which is of special importance on account of the shortage of potash and the expense of nitrogenous fertilizers.

Systematic soil surveys were carried on in many of the States, including the location of the principal soil types; chemical studies of the various types; and field, plat, and pot experiments on representative soils to determine their fertilizer and lime requirements.

Fertilizers.—Extensive fertilizer experiments on various crops were carried on by most of the stations and included such topics as the use of fertilizers in rotations and the best time to apply them, and comparisons of nitrogen, phosphoric acid, potash, and lime from different sources and in different combinations. A great deal of work was done on the use of raw ground rock phosphate and on the relative value of different forms of phosphoric acid and the rate of its application on various crops. Investigations were also made on the availability of rock potash and other domestic sources of potash, on sodium as a partial substitute for potash, on means of conserving potash, and on the relative availability of different forms of nitrogenous fertilizers. Fertilizer inspection continued to be carried out by the stations in a considerable number of States.

Agricultural botany.—Among the subjects studied in agricultural botany were plant correlations related to yielding capacity, the effects of pollen from barren stalks of corn, the effect of environment on the rice plant, botany of *Lespedeza striata*, the distribution and eradication of wild garlic, and the function of sulphur and chlorin in the plant.

Extensive investigations on the principles of plant breeding and the application of the laws of inheritance to special crops were carried on at many of the stations. There was a large amount of breeding and selection work aiming to improve varieties, secure immunity from disease, or emphasize some valuable character, such, for example, as increasing the oil content of the soy bean. Breeding work was done on a large variety of plants, including fruit trees, small fruits, field crops, grain, and vegetables, in part by botanists and in part by agronomists and horticulturists.

Investigations in plant physiology were a prominent feature of the work of some of the stations, and included studies on such subjects as the reactions of enzyms to solutions within the plant; enzymatic activity as a limiting factor in productivity; the conditions prevailing in plants during dormancy and the relation of that period to their future development; the wintering of cherry buds; the relations of nutrition, temperature, and moisture to variations and mutations; the development of fruit buds; the cause of the off year in fruit bearing; and the forcing of plants with various chemicals. The injurious effect of abnormal food supplies and certain organic compounds in the soil on plant growth was under investigation, as was also the poisoning and stimulating effects of insecticides and fungicides. A study was also made of the decomposition products of plant growth toxic to plants, the organisms that cause the decomposition, and the aftereffects on plant growth. Much work was done on seed treatment of cereals and other crops in its physiological relations.

Field crops.—In the study of field crops practically all of the stations carried out tests of varieties, fertilizers, rotations, and methods of seeding and culture, and did work on the improvement of crop plants by selection and breeding, and on the development of disease-resistant strains. A number of the stations studied the adaptability of new varieties to different sections of the State and the economic utilization of native food plants.

General subjects under this head included the influence exerted on plants by previous growth of other kinds of plants, the mineral requirements of crops, especially in the critical periods of growth, the water requirements of crops and its more economical use, the effect of lime on different crops, and the limiting factors in crop production. Investigations were made on seed-bed preparation, intertillage, and methods of weed eradication.

With the more important field crops, as, for example, corn and cereals, a large amount of experimental inquiry was carried on. Variety, cultural, and fertilizer tests were made to meet local needs, but in addition there was a large amount of work upon improvement by breeding, selection, hybridization, and acclimatization. Among problems dealt with in the latter studies were the correlation of in-

herited characters, the feasibility of increasing the content of certain constituents, such as fat or protein, the duration of the effects of inbreeding, and effect of inheritance on sucker formation, pigmentation, etc. The principles governing the growth and maturity of corn, the distribution of stand and its adjustment to soil types and conditions, the effect of variation in the character and composition on the vigor of the plant, and interplanting with legumes may be mentioned among other special lines of study. The growth and harvesting of corn for silage, including varieties, stage of maturity, and growing with legumes, also received attention. The storage of various crops, with a study of conditions and their effects, has been the subject of much inquiry.

The importance of the cotton crop naturally made it the subject of extensive investigation, including breeding with special regard to the relation of lint to yield; studies in inheritance; selections to secure early, high-yielding strains and wilt resistance and to develop a high protein and oil content; factors influencing earliness and study of varieties best suited for resistance to wilt and drought and to boll-weevil conditions. The cause of the shedding of young bolls, the effect of continuous culture, place and climatic variation, variety tests, rate of planting and spacing, cultivation, depth of plowing, topping and harvesting, treatment of seed, and the effect of storage on the vitality of the seed were also under investigation.

Emergency conditions directed special attention to studies of the cereals. Extensive work was conducted on the milling and baking qualities of standard wheat varieties and the relation of the soluble protein to the baking strength. Studies were also made of inheritance, the influence of environment on the wheat plant, its response to different plant foods, the relation of its composition to soil types, the relation of potash to the growth of cereals, and the influence of soil and culture on the nitrogen content and yield of wheat.

Other work with wheat included studies of the biochemical changes in frosted wheat; tests of varieties, cultural methods, dates and rates of seeding and seed selection; and variation in winter wheat. Selection experiments were under way to secure improved grain, cover crop, and pasture strains of rye and barley; to develop flour and beardless winter varieties of barley; and to secure an awnless variety of oats resistant to rust and winterkilling. The milling of grain sorghums and their use as substitutes for flours and meals made from corn and wheat were active lines of experiment.

Both Irish and sweet potatoes were subjects of much experimentation, including, in addition to variety and culture tests, a long list of fertilizer experiments, such as the potash requirements, the relative value of raw and acid phosphate, and the connection of certain fertilizers with some potato diseases. Such special problems

as storage conditions, the effect of high-yielding hills on the progeny, selection for improved strains, thinning experiments, factors influencing seed production, a comparison of northern and southern grown seed, the effect of locality on the yield, various breeding experiments, and the germination of seed for the second crop commanded much attention. In sections where rice and sugar cane are grown variety, cultural, and fertilizer tests were carried on, with the introduction and propagation of promising new varieties. Some very important work has been done in the production of sugar-beet seed, which promises to make this country independent of the European supply.

A number of experiments on tobacco were under way, including breeding, fertilization, transplanting, variety tests, priming versus cutting, curing, and rotation systems for tobacco growers.

The importance of the alfalfa crop directed the attention of a number of stations to it in cultural, variety, fertilizer, and other investigations. Extensive experiments with sweet clover were also in progress. The velvet bean is rapidly coming into prominence as a field crop for the Southern States, and various phases of its production have been studied at a number of stations, such as methods of gathering and handling the crop and the production of early maturing varieties. The peanut crop also received considerable attention by the southern stations. The culture and improvement of the soy bean and its feeding value for animals and man, as well as the saccharin and nonsaccharin sorghum varieties as forage crops, were studied.

The depleted condition of many of the western ranges has led to extensive studies on the relative importance of native range forage plants and their reestablishment, as well as the introduction of foreign varieties, and studies on poisonous range plants and methods of decreasing losses due to them. The feeding value of yucca and other forms of native vegetation in the Southwest for carrying cattle over long seasons of drought has been an important line of experiment.

Various pasture experiments were carried on relating to management and renovation, the care, fertilization, and treatment of grass lands, and the establishment and improvement of pastures; also methods, time, and rate of seeding grasses and grass mixtures for meadows and pastures, the effect of grazing on pastures, top-dressing mowings and pastures, and early spring crops for pastures. There was a large amount of work with forage plants of various kinds as to their adaptation, culture, and the like. The various phases of dry farming continue to receive much attention.

Horticulture.—Horticultural subjects engaged the attention of practically all the stations. Extensive experiments on fruit culture

were under way, including variety and fertilizer tests, pruning, the relation of stock and scion, breeding and selection, the development of hardy varieties to withstand winter injury, cross-pollination, self-sterility and self-fertility of varieties, and other questions. Fall and spring planting of trees, the effect of dynamiting ground for setting trees, orchard tillage and cover crops, wood growth under different treatment, the dormant period of trees, fruit-bud development, factors affecting fruit production, and color in fruits were important topics of study. The harvesting, storage, and marketing of fruits received much attention.

Experiments of this sort were carried on with all the leading deciduous fruits. Citrus fruits were studied in regard to their food requirements and the relation of the fertilizer elements to certain citrus diseases. Investigations on nut trees, especially the pecan, were in progress at several of the stations. Projects on small fruits include variety and culture tests, improvement of the strawberry by crossing and selection, and the influence of continued self-pollination. A few stations made experiments in blueberry culture and several studied various questions arising in cranberry growing. Work on the grape included, in addition to variety tests, selection and breeding, and studies of the muscadine grape and the fecundation of the rotundifolia group.

In olericulture most of the stations conducted variety, fertilizer, cultural, and selection and breeding work with various vegetables. Rotation and cover crops in connection with vegetable growing in the field and greenhouse and storage and marketing problems were subjects of investigations. Some special lines of study were the storing of cabbage, breeding strains of asparagus resistant to Fusarium wilt, and other diseases, selection and isolation of types of squashes, improvement of the tomato by crossing and selection, factors affecting the setting of the fruit, and adaptability of varieties; inheritance of stringiness in beans, growing onions from seed, and various experiments with broccoli.

Experiments in floriculture and greenhouse management were carried on at several of the stations and included the production and the influence of the physical factors of the soil on the growth of carnations; breeding hardy roses for the Northwest; a study of varieties, hardiness, adaptability and breeding of roses, peonies, sweet peas, gladioli, phlox, and iris; and miscellaneous greenhouse experiments.

Experiments in spraying and protection of plants against various insect and disease pests and on the efficiency of materials and apparatus were important lines of work at practically all the stations.

Forestry.—Forestry assumed an added importance during the year both from the military demands for lumber and from the necessary increase in the use of wood for fuel, due to the scarcity of coal. Many

of the stations gave considerable attention to this subject. Practical farm forestry and the management of woodlots; wood utilization and commercial tree studies, including the marketing of forest tree products and the production of walnut lumber for use in the manufacture of aeroplanes and gunstocks, are projects which received attention.

Other forestry projects included the establishment of forests of different species, the tolerance of forest trees, a study of the types of northern forests, with various forms of management; the utilization of the Adirondack hardwoods, forest arboretums, reforestation studies, and the propagation of forest trees; the introduction of new forest and shade trees; the planting of sand dunes; and testing varieties for ornamental, shade, windbreak, hedge, and building purposes.

Diseases of plants.—Plant diseases and their control form a prominent line of work at practically all of the stations, especially the diseases of food and field crops. General subjects studied included the relation of soil moisture, temperature, humidity, and other factors to susceptibility and infection; mycological studies on several groups of parasitic fungi; studies on the cause and control of individual diseases; the relation between parasitic fungi and their host plants; and the protection of farm and fruit crops against fungus diseases. Special groups of fungi and disease, such as sclerotia and fusarium diseases, were under comprehensive investigation.

Among the orchard and fruit tree diseases studied were the blight, brown bark spot, root rot, tree canker, blackheart, anthracnose, wood rot, peach yellows, plum pocket, and pecan disease. Citrus diseases received considerable attention, especially citrus canker and certain physiological troubles. Diseases of the raspberry and other small fruits received attention, also avocado diseases and pineapple wilt. Several stations carried on extensive studies on white-pine blister rust, white-pine root rot, chestnut-bark disease, and other troublesome diseases.

In case of the field crops, much attention was given to cereal diseases, especially the rusts and smuts. Many stations carried on active campaigns in barberry eradication for the control of the rust, and much has been accomplished in the development of varieties resistant to rust and smut. The fungi causing root troubles of grains were also studied. Among the numerous studies on cotton diseases were those on anthracnose and the causes of the dropping of young cotton bolls. Potato diseases received special attention at a number of the stations, including studies of the nature, cause, and control of tip burn, the relation of the character of the skin of the potato to scab, Fusarium and Verticillium wilt and Rhizoctonia disease and slime mold, dry rot, and other diseases occurring in storage. Investigations of alfalfa diseases included selection and breeding for resistance, spraying, and treatment of the seed bed and other means

of control. Diseases of sugar cane were studied where this crop is grown. Diseases of other field crops that were under investigation include frog-eye, mosaic disease, wilt, blight, and wildfire of tobacco; a bacterial disease of the soy bean; peanut diseases; the diseases of clover and its resistance to anthracnose (*Colletotrichum trifolii*), the causes of flax wilt and the development of resistant strains; the cause and control of black rot, yellows, and blackleg of cabbage; and bean diseases, especially rust and its control.

Diseases of the watermelon studied included bacterial wilt and Fusarium wilt. In case of the tomato biological and field studies of the wilt and investigations on the resistance of this crop to the disease were made. A number of stations studied onion diseases, including the pink rot, neck rot, and storage rots. Special attention was directed to the diseases of canning crops. Other plant diseases studied include lettuce diseases, celery diseases, cucumber mildew, root knot and "damping off" in the seed bed, and diseases of ornamental plants. Extensive experiments were conducted on methods of seed treatment, especially the concentrated or dry formaldehyde method of treating oats and wheat, and the causes of seed injury, which were of special war significance. A number of the stations are conducting plant-disease surveys in their States in cooperation with this department.

Economic zoology.—Studies in economic zoology were carried on, especially in the western stations, on the control of injurious mammals, such as gophers, ground squirrels, and prairie dogs.

Entomology.—Entomological studies occupied a prominent position in many of the stations, special attention being paid to the life histories, habits, distribution, host plants, parasites, and methods of control of insect pests. Some of the more general subjects under investigation were the life history and methods of control of insects infesting cattle and swine, the cause of the periodical recurrence of insect pests, the destruction of hibernating insects in winter, parasitism as a factor in the control of injurious insects, activity as influenced by temperature and moisture, the progressive immunity of insects to insecticides, the control of insects by impregnating the sap of plants with poisons, and studies of groups or orders of insects, as, for example, the Aphidæ.

A feature of the work at some of the stations has been participation in the protection of the health of soldiers and civilians by the control of insects which transmit diseases. Attention was given to body lice, mosquito control, and the tick transmitting spotted fever to man. The Texas fever tick, the chicken tick and mite, the stick-tight flea, the life history and methods of control of the hog louse, and the stable fly were under investigation.

Numerous studies were made on shade trees and orchard insects, including those infesting the pecan, the white ant, the locust borer, and the sycamore lace bug. Of studies of insects attacking the apple the following may be enumerated: The habits and life histories of the codling moth, apple-plant lice, the apple-tree borer, the lesser apple worm, the apple-leaf roller, the reaction of the apple-leaf miner to applications of contact insecticides, and the control of late summer apple pests. Studies were made on the insects injurious to nursery stock; on the control of fruit insects by spraying and other methods of combating these pests; spraying for the San Jose scale, the woolly aphis, the peach-tree borer, and curculio; citrus insects, especially the control of the white fly by parasites and the white-fly-eating lady beetle; the pumpkin bug as a citrus pest; the pear-leaf blister mite; and the spinning sawfly of the plum.

Investigations on insects attacking wheat and other grain included the chinch bug and its control, the false chinch bug, the prevalence, distribution, and control of the Hessian fly, the wheat strawworm and the joint worm, the western wheat aphis, the wheat-head army worm, the wheat sawfly, and the stem maggot. Corn insects studied included the corn plant louse, the corn earworm, and the recently imported European corn borer. Cotton insects under investigation were the boll weevil, root louse, and stalk borer.

Other studies on insects attacking field crops included the rice weevil; the cowpea louse; clover insects; bean pests, including the bean beetle and the bean and pea weevils; alfalfa insects; the potato flea beetle; the sweet-potato weevil, sugar-beet insects, including the sugar-beet louse and webworm; and the velvet-bean caterpillar. Work was also carried on with insects attacking the melon, means of control of the onion maggot, the Harlequin cabbage bug and cabbage worm, the slender wireworm, the tobacco worm, euthrips, control of nematodes, morphology of the plant lice and their relation to spinach blight, cranberry insects, grasshopper and cutworm control, the field cricket, the black fly, and the economic importance of the digger wasp. Considerable work was done on the scale insects, especially on the control of the armored scales and the gloomy scale.

Investigations were actively pursued on insecticides and spraying material and apparatus, including especially such subjects as the burning of foliage by arsenicals, the toxic value and action of insecticides, a comparison of dust and liquid sprays, trials of new insecticides, the effect of cuprammonium washes and Bordeaux mixture, tests of spray nozzles, and methods of control by fumigation. One station as a result of its studies on insecticides was able to assist in devising means for the destruction of body lice, that great bane of the soldier at the front.

Beekeeping.—Various problems in apiculture and the production of honey assumed special importance during the year owing to the limited sugar supply. Among the apicultural subjects studied were the wintering of bees; bee diseases, as, for example, honeybee paralysis; poisoning bees by spraying trees while in bloom, methods of extracting beeswax, the development of pure Italian queen bees, artificial impregnation of queen bees, the reproductive capacity of Carniolan and Italian bees; and surveys of honey-producing plants.

Foods and human nutrition.—Studies in foods and human nutrition were mostly in the line of conservation of food materials by canning, drying, and curing. Recipes for new uses of foodstuffs were worked out with special reference to the conservation of wheat, sugar, meat, and fats. An interesting study was made of the factors influencing the food value of cows' milk, especially for infants and invalids. Other lines of work in this field included the use of frozen potatoes for making flour, the use of dry sugar-beet powder as a substitute for sugar, and a study of textiles to encourage the larger use of cotton clothing as a substitute for woolen goods.

Animal production.—Various phases of animal production naturally received a large share of attention. Studies in the field of genetics in regard to the laws governing inheritance in domestic animals contributed to the knowledge of principles controlling descent. Extensive experiments were conducted in inbreeding with dairy cattle and hogs, and on the biology of inheritance in dairy cows and poultry.

Other studies pertaining to live-stock breeding included artificial impregnation, age as a factor in breeding, the effect of nitrogenous foods on breeding, experiments in the breeding of polled Hereford cattle and strains of milking Shorthorns, the development of Holstein dairy herds, and herd improvement, as, for example, by the organization of breeding circuits. Considerable breeding work was carried on with horses and mules. Experiments along this line with hogs included the breeding of young sows and the effect of gestation and lactation on the growth and composition of swine. Breeding experiments with sheep were in progress at a number of the stations and Angora goat breeding at a few. Poultry breeding work continued to be a prominent line of investigation at many stations, especially directed toward breeding for egg production and the correlation of early maturity to egg production.

A number of projects on the care and management of live stock, relating to methods of feeding, handling, and housing, such as a comparison of range and confinement, management, and feeding as related to vigor of germ, were carried on.

There were extensive studies in the principles of animal nutrition and feeding, embracing such subjects as functions of the proteins and

vitamins, protein requirements for growing cattle, mineral metabolism, relation of quantity of rations to quality of the beef and pork produced, nutrition requirements for beef production, use made of food by animals of different ages, factors influencing the normal rate of growth of domestic animals, influence of nutrition during the growing period on subsequent performance, effect of a cereal diet on the blood, rôle of phosphorus in nutrition, nutritive value of local grown feed, and effect of age on economy of grains.

The composition of various feeds and their digestibility and utilization by different classes of live stock were active lines. Experiments to test various feeding stuffs and home-grown feed were conducted on an extensive scale, and during the war included new materials and waste products, such as garbage and cannery refuse. The growth of forage crops for pasturage and the feeding of various crops in the field to save labor, the use and value of silage made from corn and other crops, the employment of legumes to replace grain feeds in part, and the maintenance of stock, stressing the more extensive use of roughage with a lighter grain ration, were especially practical lines of experiment. There was also a large amount of work dealing with the commercial aspects of feeding and live-stock farming, such as systems of management, finishing, and fattening of cattle and hogs in carload lots; and the amount of beef or pork an acre of land will produce with different rotations. The work with beef cattle continued to be especially extensive and varied, covering all the important feeds, the quality of the product, loss on slaughtering, production of baby-beef, and the like.

The growing importance of the swine industry directed a large amount of experimental work to this subject. Examples of such work which may be mentioned were comparison of common crops for pork production, the use of forage crops in reducing cost, a comparison of limited and full feeding on different forage crops, the economy of "hogging-off" crops, the use of self-feeders, and the effect of various feeds on the quality of pork. An important project in swine feeding in the South was the hardening of peanut-fed pork with other southern-grown feeds, tests to determine to what extent peanut meal can be fed and still produce a hard pork, and experiments with peanuts, soy beans, and other southern grazing crops for hogs. The value of velvet-bean meal as a substitute for corn and in connection with garbage for maintaining brood sows and the value of cottonseed meal as a hog food was studied. The factors involved in cottonseed-meal poisoning, and the avoidance or minimizing of this trouble have long been under investigation. Tankage and other supplements for corn, and the value of rice products, were other subjects of experiment.

Experiments in the management and feeding of horses were carried on at some of the stations, including the cost of raising farm horses and of feeding work stock.

A number of the stations conducted investigations in sheep husbandry, dealing with feeding and management, maintenance, and winter rations for breeding ewes. Experiments to establish a breed of sheep for winter lambing were in progress, as were studies of fall forage for fattening lambs; the rate, economy, and character of gains made by lambs of different breeds and ages; the use of silage for lambs; and the fattening of range lambs. Experiments relating to the effect of various factors on wool production, inheritance in wool production, the effect of rations containing a high sulphur content on the fiber, and on the effect of alkalis and weathering on wool, and on methods of testing the fiber were also carried on.

Most of the stations were engaged on problems connected with the advance of the poultry industry such as methods of breeding, feeding, and management of flocks; housing, care, and marketing; and the economical production of eggs and market fowl. These included the use and value of various feeds for this purpose, breeding for egg production, the effect of age and the influence of the male, animal foods for forcing egg production, a comparison of egg production from pullets hatched in February, April, and June; and the cost of egg production. The value of velvet-bean meal and other protein feeds was tried, also various grain rations and substitutes for wheat for laying hens.

Experiments were in progress on the value of crate fattening roasters; a comparison of cockerels, capons, and pullets for meat production; and the cost of production of mature pullets. Studies were also made on the optimum conditions for artificial incubation, on incubation temperatures, the physiological zero point of germ development, the cost of hatching a chick, the growth of chicks, and rations for chickens. Other subjects studied included broodiness and methods of preserving eggs for winter use.

Dairying.—The feeding of dairy cattle and the utilization of milk in manufacturing dairy products has long been an important and fruitful line of study by the stations. Among the feeding experiments carried on during the year may be mentioned tests of a great variety of grain feeds and combinations, by-products, and waste products; a comparison of corn silage with sorghum silage; the value and digestibility of sunflower silage; the value and method of feeding velvet beans and velvet-bean meal and comparisons with soy beans, peanuts, and cottonseed meal.

The feeding value of mature as compared with immature corn, a comparison of alfalfa and red clover for milk production, the re-

placement value of legumes in dairy production, a comparison of the proteins in different feeds, and the protein and energy requirements for milk production were subjects of study. Other dairy feeding problems included winter rations for dairy heifers, a comparison of wide and narrow rations, the value of grasses and grass-like plants as pasture, various rotations with special reference to their value to the dairyman, the cost of raising dairy heifers, the rôle of water in the dairy-cow ration, and the value of dairy-bred steers for meat production in the dairy herd.

Extensive experiments in the feeding and raising of calves included a comparison of pasture-grass hay with sorghum silage for wintering weanling calves, the value of cottonseed meal for calves, their maximum and minimum protein requirements, and a study of the efficiency of milk substitutes.

Various projects relating to milk and its production and other dairy products were studied, such as composition and methods of testing, the management of dairy industries, and the most improved methods for production and marketing. Milk production problems included milk sanitation; the handling and delivery of market milk; the bacterial flora of milk; factors determining the value and influencing the composition of milk, especially the effect of different feeds; the proteins of cow's milk; the cost of producing market milk; and a comparison of milking machines.

Work upon butter had to do with its manufacture, composition, and marketing; chemical and bacteriological studies, especially in regard to its keeping qualities; and the causes of inferior butter and of fishy and other undesirable flavors. Studies in the making and curing of American and various fancy cheeses were also carried on. Commercial ice cream making and the use of sugar substitutes in ice cream were also studied.

Veterinary medicine.—Animal diseases and their treatment received much attention at the stations. This work included the study of the leading diseases and many local troubles; methods for the preparation of biological products for use in protecting animals against disease; the production and distribution of veterinary biological products, vaccines, serums, and bacterins for controlling contagious diseases of live stock; live stock sanitation; the rôle of immunity; inheritance and transformations as a means of combating communicable diseases in animals; and laboratory diagnosis.

Studies on contagious abortion included the immunization of horses and cattle against the disease by the use of serums and vaccines, the raising of infection-free offspring from infected parents, and the transmissability of the disease to swine. Hog cholera received much attention at many of the stations, which not only carried out extensive vaccination for its control but made studies on the immunity of vac-

cinated hogs, immunity of suckling pigs, and the vitality of hog-cholera virus. Researches in connection with tuberculosis and the tuberculin test, especially as to the technic of the various methods and their accuracy, were in progress.

Other subjects receiving attention were immunization against blackleg and anthrax and the dissemination of the latter disease by insects, particularly flies and mosquitoes; a study of botulinus, particularly in horses; equine anemia and swamp fever in horses and mules; hemorrhagic septicemia; the distribution, cause, and control of "milk sickness" or trembles; biting flies of cattle as spreaders of disease including the ox-warble fly; necrobacillosis; various animal parasites; the cause and prevention of hairless pigs; and prevention and treatment of sterility in cattle. A number of southern stations took an active part in tick eradication. Investigations were in progress on swell head of sheep and goats; stomach worms, muscle parasites, and tapeworms of sheep; and the changing of pastures for the control of sheep parasites. Studies were made on mixed infections of swine and a disease causing paralysis of the hind legs. Poultry diseases under investigation included among others bacillary white diarrhea, fowl cholera, blackhead of turkeys, gapeworms, roundworms, and tapeworms of poultry.

Live-stock poisoning by poisonous plants on ranges was an important subject of investigation at a number of stations.

Rural engineering.—Investigations in rural engineering were quite extensive, especially in connection with irrigation and the crops and rotations suited to this type of farming. Pumping for irrigation, irrigation for humid climates, water in relation to crops, the application of water, methods of using a limited water supply to secure the greatest crop production, the stage of growth at which water is most essential, the composition of irrigation waters, and ground-water development were studied at various stations; also the intensive cultivation of irrigated lands, and the utilization by dry-farming methods and by grazing of lands for which there is but a limited water supply.

Other engineering subjects included drainage, tractor farming, tillage implements, power machinery, farm structures and structural strength, silo construction, rural water supplies, farm sanitation and sewage disposal; also ice making on the farm, and the preparation of alkali-proof cements. Investigations were made on combustion and fuel consumption in sugar-house boilers, and means of introducing more efficient equipment and better boiler-house practice.

Rural economics.—Studies in rural economics, including farm management, related to a comparison of live stock and grain systems of farming, a study of methods of farm practice, types of farming adapted to cut-over lands where beef and hog raising predominate,

the distribution of farm labor, cost of living on the farm, systems of renting land, farm cost accounting, cooperative organizations for marketing and buying, agricultural insurance and credit, and public markets. The cost of production of various crops and of the products of live-stock farming and the marketing and distribution of such crops and products are under investigation.

Inspection and control.—Inspection and control work was carried on as usual by many of the stations, including fertilizers, seeds, feeding stuffs, human foods, and drugs; the inspection of nurseries and apiaries; creamery licenses; and stallion registration. Special lines of control at some of the stations dealt with the white pine blister rust, the gipsy moth, and mosquitoes.

MODIFICATION OF THE WORKING PROGRAM AS A RESULT OF WAR CONDITIONS.

The extent to which the working programs of the stations were modified as the result of war conditions varied according to circumstances. Taken as a whole, the work of the stations since their inauguration might almost be said to have been in preparation for the recent world crisis. When the demand came for increased production of cereals, live stock, dairy products, poultry, fruits, and vegetables, information that made it possible to bring production up to the highest point was largely at hand. Many of the teachings had already been extensively embodied in practice. The logical procedure under war emergency conditions appeared to be in the main to relate the programs of work as closely as possible to practical conditions, to urge more strongly the application of the results in practice, and to add to the fund of information in special directions as required.

In a number of the stations it was found that so many of the current projects had such direct application to immediate food production that relatively little change in the plan of work was made necessary by the national crisis, and the stress laid upon the importance of food production only emphasized the value of their study.

In many instances, however, it was evident that some features of the program were more important for the time being than others, and this led to a certain amount of adaptation of the work, amounting in some cases to a considerable reorganization. While the lines of work in progress were not dropped entirely, they were so planned that the subjects having a more practical and immediate application were given prominence. A few examples of this may be mentioned as indicating the general policy of the stations.

The discovery by the Louisiana station of a new decolorizing agent hastened the solution of the problem of the manufacture of white sugar directly on the plantation, thus enabling the sugarhouse to operate also as a refinery. At the Massachusetts station special emphasis was laid on the principles underlying the preservation of food by canning. Many of the stations cooperated with the extension services in campaigns along special lines, such as those inaugurated by the Nebraska station for extending potato culture in the State, the pinto bean campaign in the Southwest which resulted in 15,000 acres being planted where no crops had been grown before, the "increased pork" and "more sheep" campaigns, and a cottage-cheese campaign as a food conservation measure.

The animal husbandry work at the Pennsylvania and other stations was modified to the extent of placing special emphasis on investigations looking to the elimination of grain, as far as possible, from feeding rations. New direction was given to the experimental work because of the scarcity of grains commonly used as dairy feeds and the need of greater utilization of home-grown roughages. Much attention was given to the utilization of by-products.

The Council of National Defense suggested a number of problems which were made the subjects of special studies by several of the stations, as, for example, the maximum and minimum protein requirements for the normal growth of calves.

Special attention, as a war measure, was directed to diseases and insects affecting crops during growth and storage. The discovery by the Massachusetts station of a newly imported serious insect pest, the European corn borer, was of great significance, as it enabled timely measures to be taken for the control of a serious menace to this important staple crop. Efforts were concentrated on the cricket problem in South Dakota and on the grasshoppers at this and other stations, on account of the severe grain losses from these insects. The results of the investigations on the control of the corn weevil at the Alabama station promise a great saving of this crop in the South. The New Jersey and other stations gave special attention at the request of the War Department to the control of mosquitoes and other insect pests at the Army camps.

The situation in regard to seed corn in 1918 called for special action by the stations in the corn belt, with gratifying results in securing sufficient seed to meet the demand. The stations in California, Colorado, Nevada, Utah, and other States pushed important irrigation experiments to a conclusion, resulting in the opening up of much land for farming that was formerly unavailable.

A timely and important line of investigations, which was participated in by many of the stations, related to methods of making raw rock phosphate available by composting with sulphur and other ma-

terials. The cutting off of the potash supply gave special significance to the experiments at the Rhode Island and other stations on limiting the use of potash and utilizing local sources.

The veterinary departments of the stations gave increased attention to the production of immunizing vaccines for live-stock diseases, thus contributing largely to increased meat production. Poultry experiments assumed a prominent place, especially in culling out unprofitable fowls and in increasing egg production by the use of feeds other than the grains suitable for human food.

Problems which had extended over a number of years were not dropped, but in many cases were temporarily suspended or only such data on them secured as would insure their continuity when normal conditions were again established. The more strictly scientific phases gave way for the time being to practical problems.

In some cases the loss of men from the staff necessitated modifications or the suspension of certain projects. This was contributed to by the inability to get certain materials, the high price of equipment and supplies, and the uncertainty of securing labor.

Special attention was given to the dissemination of information that might be helpful in farm practice and to the publication of all available data that would be of use in promoting food production.

WORK AND RESULTS HAVING SPECIAL SIGNIFICANCE TO AGRICULTURE IN WAR TIME.

Soil studies form an important part of station work, and the various investigations on the availability and utilization of plant nutrients under different methods of treatment have played a prominent rôle in maintaining and increasing soil fertility and thereby contributing directly to increased production.

The New York Cornell station has found no evidence that lime increases the solubility of the potash, in the soils studied. Studies made on the composition and properties of different soil types, and to ascertain if soils of the same type taken from widely different localities have similar fertilizer requirements, have indicated that all important soil types of the State require potash if the best yields of crops are to be obtained. On the other hand, long-continued experiments at the Virginia station have shown that the principal element of plant food required for most of the soils of that State is phosphoric acid, and that for most general farm crops nitrogen and potash may be dispensed with in commercial fertilizers, provided a crop rotation is adopted which will bring a leguminous crop on the land every few years and that live stock is kept on the farm and the manure returned to the land. Potash applied to these soils

rarely yields sufficient to pay the cost of its purchase, except with tobacco, potatoes, and truck crops in some sections.

At the Pennsylvania station phosphorus was shown to be the limiting factor in crop production for most soils of the State, and farmers were urged to increase the use of this element. Studies by this station led to the conclusions that the scarcity and high price of potash need not seriously affect crop production for the time being, and farmers were advised to omit this element from their fertilizers for general farm crops and to make available the large amount of potash in the soil by the use of manure and lime and by turning under green-manure crops. It was demonstrated that earlier potash dressings, on the heavier soils, remain available for some time, diminishing or removing the need for current dressings so far as cereal or hay crops are concerned, although such crops as tobacco, potatoes, and other large potash consumers may need it.

Studies on the soil solution at the Michigan station showed that the amount of material it contains varies with the season, depth of soil, texture, and cropping system followed. In autumn and early spring very small quantities of soluble matter are found in the soil. The most active portion is the first six inches, variation in the subsurface and subsoil being much less. Owing to the removal of soluble matter from soils by rains, indications are that the most economical application of soluble fertilizers is in small amounts in the spring. "Sick" greenhouse soils were found to contain large amounts of soluble salts. When these were removed by leaching the soils were again productive. In muck deposits a large amount of soluble material was present in the growing season. Examination of the physical and chemical properties of the soils of 25 counties in the State showed the advisability of the more general use of lime and phosphorus and the need for increased acreage of clover. An examination of the organic nitrogenous compounds in peat soils showed them to be highly resistant to decomposition under some conditions.

Several of the stations have carried on investigations bearing on soil acidity and lime requirements. The results of these studies are seen in the great traffic in lime and ground limestone that has recently developed and in the increased yields of clover and other crops that are realized in regions where lime is being used. Studies at the Pennsylvania station showed that moderate applications at comparatively short intervals are more economical than the application of large amounts at one time. Experiments indicate that the downward movement of lime is slow, when applied as a top-dressing to close-textured soils, and emphasize the necessity of thoroughly working the lime into the land and of having it sufficiently fine for thorough admixture with the soil.

As a result of investigations at the Tennessee station liming was urged as an especially important war measure, 2 tons of ground limestone or its equivalent per acre, increasing the yield of corn, wheat, and other grains as much as 20 per cent. Soy beans and cowpeas crops were increased from 20 to 40 per cent. Clover was greatly helped, liming frequently making the difference between success and failure.

Fertilizer studies have occupied a prominent place in station activities. By special request of the committee on sources of nitrogen of the Council of National Defense, the problem of nitrogen fixation was taken up by the California station to determine whether the total and available nitrogen could not be increased by the proper supply of energy to the soil, and for other technical means. Experiments showed that the cheapest source of nitrogen was leguminous winter-cover crops. At the citrus station, at Riverside, both phosphoric acid and potash were found to have little effect in the orchard, and could therefore profitably be omitted for a few years at least.

Fertilizer experiments at the West Virginia station with vegetables and fruits showed that nitrate of soda is the most important material for orchards and a combination of nitrate of soda and phosphate for use with truck crops. An examination of sulphur balls occurring in coal mines showed a possible source of sulphuric acid for the manufacture of fertilizers. The Rhode Island station had been conducting timely experiments on the value of potash manufactured from ground feldspar, and on the substitution of common salt and soda ash for potash salts. The California station investigated such possible sources of potash as tule, the ash of redwood sawdust, and other waste materials containing a high percentage of this element.

An interesting study was conducted at the Wisconsin station on the use of buckwheat as a means of utilizing raw rock phosphate. This plant has a very acid juice and is apparently able to make use of this form of phosphorus to a considerable extent, and by plowing the crop under the phosphorus is returned in an available form.

In the field of agricultural botany some interesting indications have been obtained at the Oregon station in regard to the relation of plant nutrition to reproduction, the investigations being carried on with the tomato plant. It was found that with a low carbohydrate supply and with minimum possibility of its elaboration, even though nitrates and moisture are present, reproduction is nearly or completely suppressed and vegetation is greatly decreased or very sparse. With an abundant carbohydrate supply or the possibility of its continuous manufacture and a copious nitrate and moisture supply the plants are extremely vegetative and nonpro-

ductive. With a proportional increase of carbohydrates in relation to the available nitrates the plants are less vigorously vegetative and markedly reproductive; and with greatly diminished nitrates and moisture supply and a large carbohydrate accumulation there is a marked suppression of vegetation and of reproduction. It would seem from these indications that there are two conditions of starvation, one due to lack of carbohydrates and one to lack of nitrates; that when there is an abundance of nitrates and moisture and an abundant supply of carbohydrates, the latter are utilized in combination with the nitrogen and the result is vegetation with little or no storage carbohydrate. When, however, the nitrogen supply is less abundant in proportion to the carbohydrates manufactured the latter begin to accumulate, with the results indicated above.

In work at the Wisconsin station on sulphur nutrition of plants elementary sulphur, when used in as high an amount as 200 pounds per acre, gave a toxic effect, or at least a nutrient disturbance in some types of soils. Calcium sulphate had a much more marked stimulating effect on clover than sodium sulphate.

Studies at the Massachusetts station on the optimum light intensity for plant growth have had a direct bearing on increased food production and conservation. In field crop studies at the New York Cornell station experiments as to the best time to fertilize in a six-year rotation of corn, oats, and wheat, followed by three years of grass, figured both on pre-war and war-time prices, showed that the fertilizers were most profitably applied to the grass rather than to the grain, evidently because the increased yield of grass carried with it a heavier sod to be plowed under, thus enriching the soil in organic matter. At the Utah station the staff undertook the task of increasing the war crops, wheat, and sugar beets, and were very successful in their efforts, increased acreages being planted and better yields secured.

The work of the Tennessee station in showing farmers how to grow alfalfa has resulted in this crop being grown extensively in the State. At the West Tennessee station with the aid only of lime and inoculation, alfalfa was found to grow with unusual vigor on old cotton lands which had never been considered suitable for such a crop. The result has been to stimulate alfalfa growing and arouse interest in a crop of the greatest value for feed and pasture and as a soil improver. Experiments with buckwheat at the New Hampshire station showed that this crop requires a supply of potash, in addition to that stored in the seed itself, within a few days after germination. Similar studies with corn showed a like need. The Iowa station found that soft corn can be dried by forcing air heated to 160° to 180° up into the middle of the crib, and that salting soft corn reduces the amount of molding.

The disastrous early freezes of 1917 ruined much of the seed corn in the corn belt. The Illinois station took an active part, with very satisfactory results, in the seed corn campaign in that State, conducting over 7,500 tests in duplicate. A similar campaign was carried on by the Nebraska station to secure good seed from a crop that was decidedly inferior, more than 80 per cent showing poor germinating qualities. A normal stand and acreage were secured, but the yield was reduced by drought. The Ohio and Kansas stations were also instrumental in securing safe seed corn and distributing it, resulting in a great saving to the farmers in these States. It is doubtful if this emergency could have been met effectively without this service. By special effort of the Connecticut State station in canvassing and testing seed it was made possible for every farmer in the State to secure a sufficient supply, with the result that there was little loss from defective seed.

Corn experiments at the Alabama station have established the following facts: The relatively high productiveness of the prolific two-eared type, the supreme need of the corn plant for nitrogen, the practicability of making more general use of legumes as catch crops in the corn field, the profitableness of utilizing various legumes as crops preceding corn in the rotation, the advantages of certain types of ears and of plants for definite purposes, and the great importance of timely shallow culture.

In response to demands of the War Department for increasing supplies of long-staple cotton for its program of aeroplane manufacture, the California station took part in efforts which resulted in about 2,000 acres of this type of cotton being planted in the southern San Joaquin Valley and about 1,000 acres in Imperial Valley, as compared with a total of about 1,000 acres in previous years. Breeding work at the Oklahoma and Tennessee stations resulted, in both States, in the development of a superior variety of large-bolled, early-fruiting cotton, adapted to boll-weevil conditions, which was distributed.

Experiments on the late seeding of winter wheat at the Iowa station indicated that it is much less subject to winterkilling, will escape the Hessian fly and can follow other crops. Efforts to increase winter wheat acreage by the Nebraska Station did much to maintain the acreage for 1918 in the face of failure of winter wheat during the previous year, placing the acreage above the normal. A similar campaign by the Indiana station resulted in a 25 per cent increase. The North Dakota station demonstrated that wheat weighing only 35 pounds per bushel will make good flour. A study at the Colorado station of emmer flour to determine its value for bread making as compared with wheat flour, gave very favorable results. The Michigan station has developed for distribution improved strains of oats, barley, and rye.

A new grain sorghum, the "Darso," was developed by the Oklahoma station, which has proven to be the safest feed crop for the central and eastern sections of the State. It is becoming popular and farmers are depending on it for a safe, satisfactory feed crop. Special efforts have been made by the Delaware station to introduce the soy bean as a food. An exceptionally promising new strain of annual white sweet clover was found and developed by the Iowa station.

Several years ago the Arizona station developed the tepary bean, studying it exhaustively from various points of view and demonstrating its place as a useful food crop in arid sections. With the coming of war conditions it sprang into great prominence and the demand for seed could scarcely be met.

The New Mexico station did several seasons' work on the pinto bean, which served to bring it into prominence. It is rapidly becoming one of the most important cash crops of the State and a great source of human food. A by-product resulting from grading and cleaning the beans gives great promise as a feed for live stock. The same station made extensive experiments which indicated the feeding value in an emergency of soapweed (*Yucca elata*), a native plant growing wild over great areas in the southern half of the State.

An important contribution to agriculture was the introduction of a new variety of cereal from Russia, called "Proso," by the South Dakota station. This is a millet that is much used for food in Russia. A hulling machine for the crop was imported. The object was to get people interested in using this millet for bread and as a breakfast food, thus lowering the consumption of wheat, some of the recipes recommended reducing the wheat to 25 per cent and others eliminating it entirely. It has proven very productive in the hands of many farmers in the Northwest and is arousing considerable attention.

The stations over a wide area joined in the campaign for the eradication of the barberry, which serves as a host for the fungus causing rust in wheat.

The supply of European sugar-beet seed being cut off on account of the war, the beet-sugar industry was seriously threatened. The Utah station has for many years investigated the problems involved in producing domestic beet seed, and was therefore able to give very definite advice in regard to establishing a beet-seed industry at home. A number of stations made and distributed at cost cultures for inoculating legumes in order to increase the acreage of clovers, peas, and other legumes, with very satisfactory results.

Horticultural studies at the Iowa station showed that in apple orchards under clean cultivation the loss of trees from winter

injury was noticeably greater than where the land was kept in blue-grass sod or legume crops. Experiments in citrus fruits at the Florida station, with high and low potash and phosphoric acid fertilizers, did not show marked differences in growth and yield, but did show some differences in the quality of the fruit. Potash tended to produce a somewhat harder rind, which shipped better, but there was no apparent difference in the sweetness of the fruit. An apparent relationship was found to exist between the dormancy of the tree and the growth, yield, and color of the fruit. Overdosing with lime tended to produce frenching. As a result of experiments in date culture at the Arizona station, the growing of this crop promises to be a valuable industry in the Southwest.

The Texas station has developed a fertile hybrid between the red raspberry and the southern dewberry that promises to be for Texas what the loganberry is in the West. These hybrids are growing uniform in the third generation. Grape growers report that the yield has been increased from 25 to 49 per cent by adopting the long cane spur renewal system of pruning introduced by the Iowa station. Apple spraying experiments at the Oklahoma station resulted in a spraying schedule which increased the yield in some cases 250 per cent.

Investigations of the California citrus experiment station show that the cheapest means of supplying nitrogen to the soil is through the use of leguminous winter cover crops. In view of the great war demand for commercial nitrogenous materials, the station has advocated the extensive use of such cover crops with marked results. The work of this station also brought out the important practical fact that potash and phosphoric acid show little effect on citrus fruits and can therefore be omitted from fertilizers for citrus groves for a few years.

Experiments at the Florida station indicated the necessity for soluble phosphorus for the early growth of the potato and of potash for the development of the tubers. The necessity of having the soil for potatoes well prepared to allow proper ventilation, in order to secure a maximum crop, was shown by the Maryland station to be due to the carbon dioxid given off by the metabolism of the seed piece, resulting in the accumulation of this gas in the soil, retarding the sprouting and growth of the seedling. The New Hampshire station showed that potatoes in storage undergo but little loss of weight in reduced oxygen as compared with those in normal air, provided the water transpired is removed without too complete dehydration of the atmosphere. Important work has been done by the Delaware station in showing sweet potato growers how they can store their products without material loss, based upon experiments in which this loss was reduced to 3 per cent.

A careful study was made at the Michigan station of the rate of growth of timber, per acre, in woodlots, from which valuable data were secured as a basis for recommending the cutting of cordwood on farm woodlots. A survey was carried out to determine the amount of willow and sumac available in the State for medicinal and tanning purposes. Studies on the tolerance of forest trees by the Vermont station showed that moisture is in many cases the determining factor rather than light.

The work in plant pathology has formed a prominent part in the activities of practically all of the stations and has been of great and direct value in increasing production. Unusual vigilance was exercised in watching for the appearance of disease, and the stations cooperated with the Federal Department of Agriculture in maintaining a plant-disease survey. New diseases that appeared received immediate attention to prevent their getting a serious foothold. A very important phase of the work that received attention with valuable results was the treatment of seed with fungicides. Another valuable method of control that has been successfully carried out in many cases is the development of resistant strains. Still another method is the removal of alternate hosts, as the Iowa, Virginia, West Virginia, and other stations demonstrated in the case of cedar rust of apples, for instance, which can be practically eliminated by removing all cedars from the vicinity of the orchard. Removing and destroying all diseased parts was found to be applicable in many cases with excellent results.

In connection with investigations on plant diseases, studies have been made of fungicides and their physiological effect on the plant, together with methods of applying them. As an example of these studies the work of the New Hampshire station may be cited. This station found that cuprammonium washes were more efficient and effective than Bordeaux mixture when large amounts of soluble copper are required. They should not be used in lieu of Bordeaux mixture when the latter yields sufficient soluble copper to give protection. Transpiration in the plant was found to be increased by spraying with a 1 per cent Bordeaux mixture in which the ratio of copper and lime was 1:1, this being due to the excess of lime rather than to the copper salt. A 1 per cent mixture had more of a depressing than a stimulating effect, which, however, was less marked when the plants were grown on a low percentage of water or in strong light. Soil fertility was without effect on the stimulating action of Bordeaux mixture.

The control of insect pests attacking food crops has received much attention, resulting in a large increase in yield. As examples may be cited the success of the Colorado station in controlling the spotted

bean beetle, which had become a serious pest in the eastern part of the State, by the use of arsenite of lead. Nematode control and other entomological studies by the Florida station have served to keep pests in check both for the citrus and truck grower. Promising results have been obtained by the Louisiana station from the importation of parasites of the sugar-cane moth borer. The Minnesota station pursued studies on the eradication of the clothes louse, as a war project, for the Council of National Defense. Studies were made by the New York Cornell station in clover insect pests, which, in view of the use of the crop in maintaining soil fertility, was a factor in food production. Work with the clover aphis, at the Idaho station, has resulted in increased attention to the industry of clover-seed production and indicates that a rehabilitation of this most important crop will result in the irrigated regions of the southern parts of the State.

Investigations in apiculture at the Iowa station showed that it was cheaper to overwinter colonies of bees than to purchase new ones in the spring. About 17 pounds of stores was found to be necessary for wintering a colony from October to April. Where climate and soil conditions were favorable, white sweet clover was estimated to furnish from 150 to 200 pounds of honey per acre. A bee range survey of a part of the State, by the California station, showed favorable locations for 10,000 colonies with a possible annual production of 200,000 pounds of honey.

Studies in human food problems have received attention at a number of the stations, especially food preservation. Results of work at the Maryland station on the food value of various milks for infants and invalids showed that digestibility of the milk is not a breed characteristic and does not depend on the fat content to any extent, but is a permanent individual characteristic of the cow. The curd of some cows' milk is softer than that of others, this seeming to bear a close relation to the calcium content. Results of investigations at the California station in home drying, both artificially and in the sun, canning without sugar or using grape sugar, salting and pickling of fruits and vegetables aroused much interest, and studies of commercial drying resulted in interesting several companies in drying vegetables for war purposes.

Many food substitutes were examined by the stations and some new ones devised. For example, the California station, at the suggestion of the Federal Food Administration, examined burro meat, Belgian hares, bolted flour from grain sorghums, and other meals offered as wheat substitutes, including barley flour and breakfast foods. The Arizona station demonstrated that such materials as milo maize, feterita, and Kafir corn could be manufactured into cheap meals for human food, thereby releasing larger quantities of wheat for war purposes.

The Washington station also did valuable work on substitutes for wheat flour. The dietary qualities of barley were studied in detail at the Wisconsin station. This was of importance because of the general use of barley as a wheat substitute. Barley was found not to differ materially in its essential nutritive constituents from other grains. It was demonstrated that 60 per cent of barley in the ration suffices to furnish an abundance of water-soluble vitamin for growth. Carrots were found to be particularly rich in vitamin.

The scarcity of sugar gave great importance to the investigations carried on at the Hawaii and Louisiana stations on the production of sugar cane. Without the scientific investigations of the Hawaiian Sugar Planters Experiment Station in past years it is safe to say that the islands would have contributed far less sugar during the war period than the some 600,000 tons per annum that was produced there. The California station instituted a campaign for the increased growing of sweet sorghum for the production of sirup, and also demonstrated the feasibility of making a palatable sirup for cooking or table use from grape juice, with calcium tartrate as a by-product. Special investigations were carried on at the Minnesota station on sugar substitutes, including the production of sugar-beet sirup and the utilization of dried-beet pulp. The results of station work in making ice cream successfully with the use of several substitutes for cane sugar had a special war-time application.

Of great importance in connection with nutrition problems of man and animals is the work on proteins and other important bodies which has been carried on by the stations for the past 25 years, in which the systematic investigations of the Connecticut State station are conspicuous. This study has established with substantial accuracy the ultimate and proximate composition of a large number of protein bodies, proving that while their ultimate composition is in many cases nearly alike, they differ widely in the nature and relative amount of their complex constituent radicals. As a result there followed a very extensive study of the relative nutritive value of these individual proteins, by newly devised methods which for the first time made such tests possible. Incidentally this work showed the futility of many of the short-time feeding tests, the results of which have often been given a confidence which they do not merit. The study of the nutritive value of different single proteins showed that "protein" was not assimilated as a unit but rather that each form of protein is a complex of nutrients (amino acid and bases) from which the required elements are selected by the body, others being rejected. The very different requirements for growth and for maintenance have been demonstrated. By the methods used it has been possible for the first time to determine the relative importance of each mineral element in nutrition as well as the nature, importance, and relative

amount of vitamins existing in various feeds of animal and vegetable origin.

Some interesting results have been obtained in animal nutrition at the Wisconsin station relating to mineral metabolism. Inhibition of growth was obtained by withholding certain mineral elements, such as calcium, potassium, and chlorin. Both the magnesium and sulphate radicals were found to be indispensable, at least for growth. In a comparison of nutrients from single and from different plant sources on the development of animals, troubles in reproduction were noted in feeding oats alone to cattle. These were not due to low protein or vitamin. In similar studies in poultry, on a restricted corn diet, the pullets all died in less than four months. With the addition of calcium carbonate the pullets lived over 300 days, and the addition of potassium phosphate and calcium lactate gave still greater improvement. On a diet of wheat alone, results were similar, but the addition of calcium carbonate and lactate and potassium phosphate resulted in little or no benefit. The addition of butter fat to the ration, however, gave very decided improvement.

The stations have done much along the lines of increased and cheaper production of meat and dairy products and food conservation by emphasizing the use of by-products in place of grain needed for human food and by showing the value of home-grown feeds. This work proved of much importance to the live-stock industry under war conditions. For example, the work of the Tennessee station along the line of feeding and finishing stock with a minimum amount of grain in the ration, through the use of palatable roughages and by-products, such as cottonseed meal and hulls, proved that a moderate degree of finish could be secured profitably with these materials. The feeding experiments at the Wisconsin station have thrown new light on the value of roughage. The stations in the Southwest demonstrated that certain native plants, such as the yucca and sotol, could be used as an emergency feed for range cattle during periods of drought, thus saving a large number of cattle that would otherwise have perished. The Iowa station showed that a ration of 14 pounds of shelled corn, 3 of linseed meal, 36 of corn silage, 1 of hay with a little salt daily, for fattening cattle, gave a larger margin of profit per steer than any of the rations containing commercial feeds. At the Pennsylvania station several lots of cattle were fed successfully on corn silage and cottonseed meal only, without the use of additional grain, and the beef-breeding herd was maintained entirely on roughage, supplemented with a limited amount of cottonseed meal. The North Dakota station found that close-grazed ranges gave greater gains in weight of cattle per acre during the early part of the following season than less closely grazed, and that much more meat was produced per acre by this practice.

The campaigns of the Arizona station for an increased number of food animals, particularly hogs, sheep, and cattle, and the use of silos as a necessary measure in connection with the conservation of live stock, gave marked results. Similar campaigns for increased pork production were carried on in most of the States, especially to encourage the utilization of local-grown feeds. The Iowa station found that meat-meal tankage, next to milk and milk products, was the best for supplying a protein-mineral-vitamin supplement.

Much work was done by the stations on the use of forage crops for swine. This showed it to be possible to materially reduce the amount of grain necessary to produce 100 pounds of pork. Experiments at the Alabama station showed the unprofitableness of an exclusive ration of corn and the ease with which this loss is converted into a considerable profit by the introduction of such nitrogenous feeds as peanuts, cowpeas, soy beans, velvet beans, rape, vetch, and other forage plants, and tankage. This station has also done considerable work on the effects of various feeds in hardening the fat of hogs previously fed on peanuts. At the Michigan station hogs fed for 10 weeks on raw garbage made an average gain of only 1.33 pounds per head daily, and allowing 16½ cents per pound for pork produced, the garbage per person daily was worth 1 cent.

Work was done with sheep by many of the stations, resulting in an increased production of mutton and wool and better handling, managing, breeding, and feeding of the flocks. In experiments at the Michigan station to determine the most economical way of wintering breeding ewes, and the extent to which cheaper farm roughages could be employed, bean pods and shredded stalks with silage gave as good results as silage and clover hay and at less cost. The results at lambing time were also satisfactory.

The demand for increased food production induced many people with little or no experience to take up poultry raising. This resulted in an unusual demand upon the stations for information and help along this line. The experimental work with poultry was directed largely toward the feeding of substitutes for the grains demanded for human food. The California station found that the use of wheat could be greatly reduced by the use of potatoes and rice and its by-products. A successful attempt was made at the Idaho station to feed for egg production without the use of wheat in any form. Excellent results were obtained from the use of skim milk. At the Iowa station it was found that oats could replace wheat and its by-products up to 50 per cent with satisfactory results. Tweny-five per cent of the feed as animal proteins was found to be necessary. Early-hatched pullets, bred for egg production, were essential to secure good winter layers. The extensive poultry studies

at the Rhode Island station have done much toward stimulating the industry in the State.

Studies at the Wisconsin station on the calcium requirement of the hen for eggshell production showed that oyster shells and clam shells were more effective than any of the pure calcium salts. There were indications that this difference might be due to the presence of a small amount of iodin in the shells, which was partly confirmed by the fact that adding iodin to pure calcium carbonate supplied to the hens resulted in a larger number of eggs. At the Wisconsin station special problems in connection with the employment of carrier pigeons on the war front was taken up.

The Minnesota station carried on experiments in raising Belgian hares for meat production, and was active in advocating the use of fish as a substitute for meat, resulting in the stocking of private ponds and lakes with fish fry.

The stations did much good in demonstrating the possibility of building up a profitable dairy herd by the use of pure-bred sires, and in many places the scrub bull has been almost eliminated. Thus the Iowa station found that from scrub cows on which good bulls were used there was an increase in the second generation of 110 per cent in the amount of milk and 102 per cent in the butter fat. A herd of 40 dairy cows was maintained at this station during the summer on 20 acres of pasture, supplemented with 15 acres of soiling crops consisting of alfalfa, oats, field peas, and amber cane. Feeding experiments at the Tennessee station demonstrated that the edible grains may be entirely eliminated from the ration of mature dairy cattle by the use of cottonseed meal, velvet bean meal, and other concentrates not suitable for human food.

The results of the work done by the veterinary departments of the stations have been a highly important factor in the protection of live stock from contagious diseases. Widespread studies on hog cholera and the increasing production and use of immunizing serum is rapidly controlling a danger that seriously threatened the swine industry. This method of control has been studied and applied to other animal diseases, as contagious abortion and blackleg, with increasing success. The Texas station reports promising results in investigations on immunizing against infectious anemia. The Virginia and Mississippi stations have given special attention to the diseases of sheep and their parasites.

The increasing loss of cattle and sheep on the western ranges from poisonous plants makes the investigations of the Montana, Nevada, and Wyoming stations on this subject of great importance. The attention of stockmen has been called to this subject and directions have been issued as aids in lessening the danger of stock poisoning on infested areas.

There was greatly stimulated interest in the farm tractor. The Iowa station found from returns from many farmers that 90 per cent regarded the use of tractors as successful. The station demonstrated that soil erosion could be prevented by various means, such as dams and drains.

On account of fuel shortage and the high cost of coal and oil special attention was given by the Louisiana station to the elimination of inefficient furnace equipment and construction in sugar houses, resulting in a marked economy in fuel consumption.

As a result of a study of the disintegration of concrete silos and means of prevention the Iowa station has contributed a waterproof paint, which was found applicable for use on the hulls of concrete ships.

Much assistance was given by a number of stations in increasing the irrigation of lands capable of producing grain and forage crops. The California station helped in installing irrigation plants involving an area of approximately 2,500 acres. The possible watering of at least 30,000 acres was provided for by securing the waiving of an injunction against the opening of the Lake Land flood water canal from Kings River. An agreement was obtained from a water and power company whereby 10,000 acres of rice land were irrigated in Yolo County with water pumped from Clear Lake. A movement started by the Colorado station resulted in a large amount of irrigation water being used to better advantage, especially by those having a small water supply.

The first year of the war was one of water shortage in Nevada, and studies by the Nevada station on the relation of water and crops and methods of using water to the best advantage were particularly significant and timely. Special studies by the Utah station on ground water and pumping show that there are large areas in the State not served by irrigation canals which are underlain with an abundant supply of subterranean water, that can be pumped to the surface at a comparatively low cost. Gratifying results have been obtained from the station's experiments in the irrigation of sugar beets, potatoes, and grain.

Labor problems were acute in many sections and received the attention of some of the stations. One result of the serious shortage of labor as reported by the Mississippi station was a marked increase in the area of land devoted to pasture and live stock production. A study by the California station of the cost of production as a basis for determining wage standards, based on the usual crop yields of 20 different crops, showed that due to high prices of essential farm products, wages might exceed considerably those of normal times, possibly even be doubled, and still permit of profit.

SPECIAL WAR SERVICES OF STATION WORKERS.

Almost without exception members of the staffs of the experiment stations took an active and prominent part in the various organizations and movements called into being by the war, for the purpose of increasing food supply and for food conservation. In some instances this required quite a large part of their time and energies, while in others it was less taxing. Not only did they participate in this as members of various boards, but frequently they were called upon for advice and help as experts.

In a number of States the director of the station acted as State food administrator under the United States Food Administration, or actively cooperated with such officers, his position in charge of the research work and sometimes also of the extension work of the State giving him peculiar fitness for such duties. The local resources or industries peculiar to many parts of the country called into existence commissions whose duty it was especially to promote these, and in most cases this has naturally devolved upon experts on the station staff familiar with the local conditions. Many States organized State food committees which members of the station staff either participated in or cooperated with.

Both on the Council of National Defense and especially in the organization of the various State councils of defense there was a large enrollment of station workers, the director in many cases being chairman of these councils.

Other Federal activities along these lines in which the stations took part were those of the National Research Council, the Federal Fertilizer Commission, the Federal Wool Administration, the Federal Fuel Administration, and the Federal Milk Commission. The director of the New York State station was appointed chairman of the Federal Milk Commission for the Middle Atlantic States, whose purpose was to fix the price of milk, both to the producer and to the consumer. The director of the Illinois station spent much time on a similar commission for the Middle Western States. The director of the Wisconsin station served for a time on the United States Food Administration in connection with supervision of dairy products, and two members of the staff of the Maine station held responsible positions in that administration.

Various activities of the food production movement were carried on under different local names in the various States, as, for instance, the State committees on increased food production and conservation, the State public safety committees on food production, and State food preparedness commissions, which were largely participated in by station men.

Of the various State activities dealing with more local phases of the work, where the station's experience was often especially valuable, may be mentioned the barberry eradication campaign throughout the wheat belt, which accomplished much good in controlling wheat smut, which has the barberry as an alternate host; the section of wool industry of the War Industries Board, which was shared in by the stations in those States where sheep husbandry is prominent; local public safety committees, local war boards, State wood fuel committees of the State fuel administration, State live-stock commissions and live-stock sanitary boards, special seed corn campaign committees in the corn belt, State sugar beet commissions in those States where this is a prominent industry, State crop pest commissions, State seed stock committees, labor emergency committees of the State labor bureaus, and State committees on farm machinery and loans to farmers.

Many directors and staff members served on advisory councils to the governors of the States and on advisory committees of the United State Department of Agriculture, the United States Food Administration, State fuel administrations, and the National Agricultural Society.

Several of the scientific associations and societies of the country established war emergency boards to cooperate with the Government, in many of which members of the station staff did active service. Among these may be mentioned the war emergency board of the American Phytopathological Society, the special war commission of the American Poultry Association for the increase of poultry production, and the special war committees of the Society of American Foresters and of the American Farm Economic Association.

A few specific examples of the extent of such services contributed by some of the stations may be enumerated. The New Jersey station staff was represented by members on the State seed-stock commission, the New Jersey Alfalfa Association, the council of the New Jersey Tomato Growers' Association, and the committee on marketing alfalfa hay, and the entomologist was consulting mosquito engineer for the United States Shipping Board. The head of the animal industry department of the Montana station was with the Red Cross work in France, engaged in the development of animal husbandry. A member of the North Dakota station staff was in charge of the sugar distribution in the State and another was on the committee on pure seed distribution, actively engaged in locating and distributing seed corn especially.

The director of the West Virginia station served on the advisory council of the State council of defense as expert in the division of planning and statistics for the War Industries Board, chief statisti

cian in the Bureau of Aircraft Production, with the rank of major, and later as a member of the Army Overseas Educational Commission. The horticulturist of this station served on the advisory council of the State council of defense, the chemist cooperated with the National Research Council and was later appointed consulting chemist of the Bureau of Ordnance, the animal husbandman was appointed specialist in beef cattle production for the southeastern United States, the associate in farm management served as farm labor specialist for West Virginia, Kentucky, and Tennessee, the entomologist was appointed collaborator in the Bureau of Entomology in connection with the oriental peach-moth investigations, and the plant pathologist as collaborator in the Bureau of Plant Industry, with special work on certain wheat diseases.

At the Minnesota station four members of the forestry department were members of the wood fuel committee of the State fuel commission, one being on the special war committee of the Society of American Foresters; two members of the staff were granted leave of absence to serve on an agricultural mission to Serbia for the American National Red Cross, to bring a tract of about 30,000 acres into cultivation near Monastir, with the view of relieving food shortage in that region; two assistants in farm management were economic advisers of the marketing division of the State committee for increased food production and conservation; the agronomist was secretary of the latter committee and of the crops division and marketing division of the committee, chairman of the special seed-corn campaign committee, and also of the special committee for consumers, to review the testimony on milk production submitted to the Illinois State commission. Another member of the agronomy department was secretary to the special seed-corn campaign committee. The assistant in agricultural economics was engaged in investigational work in marketing for the State public safety commission. The assistant in agricultural biochemistry was deputy State chemist to assist in the campaign against adulterated feeding stuffs. The plant pathologist was president of the American Phytopathological Society, taking an active part in war work through its war emergency board, State leader in the barberry eradication campaign, and cooperator in charge of the scouting campaign in white pine blister rust investigations for the United States Department of Agriculture.

The animal husbandry head was vice chairman and acting chairman of the live-stock division of the Minnesota committee on increased food production and conservation. The editor of the Minnesota station was a member of the latter committee, secretary of the publicity division of the same, and a member of the executive committee of the America First Association. The director was a member of the university subcommittee of the National Research Council, Council of

National Defense, marketing division of the State commission for increased food production and conservation, crops and home economics divisions of the same commission; chairman of the executive committee of the State Forestry Board (especially in the wood fuel and spruce wood survey projects) and of the university committee of instruction in scientific courses to meet military needs. The associate entomologist had charge of the eradication of the barberry in the State. The head of the poultry department was a member of the special war committee of the American Poultry Association for the increase of poultry production.

After the close of the fiscal year the agronomist of the Illinois station and the research associate in soils at the Michigan station responded to a call from Greece for assistance in improving agricultural production in that country.

This list by no means is exhaustive, but it serves to indicate the very wide range of war-service bodies and movements which the station workers were called upon to participate in and the extent to which they took part. It is a highly gratifying recognition of their special ability and usefulness at such a time.

A great variety of campaigns were also participated in, among which may be mentioned those for increased production of wheat, sorghum, and cotton, increased crop production in the South, control of cereal diseases and oat rust, better utilization of skim milk and the greater use of cottage cheese, control of various destructive insects by the entomological and forestry departments of the stations, fire control, and production of spruce for aircraft.

Many of the western stations cooperated in supervising emergency irrigation projects and in the adjustment of irrigation controversies. Service was rendered in connection with the Signal Corps of the United States Army in castor-bean growing for the production of castor oil. Station members also served on the American agricultural commission sent to Europe to study food production, supply, and future agricultural needs in the Allied countries engaged in the war. They were called into conferences of various kinds in an advisory capacity, such as those on purchasing horses for the United States Army, on fixing prices for hogs and beef cattle by the United States Food Administration, and on soil management in the Middle West by the Council of National Defense.

Other war activities participated in included the supervision of war gardens, war savings, and Liberty loan campaigns, and four-minute speakers, as well as Red Cross and Y. M. C. A. work.

In general it may be said that the States have looked to the stations for leadership in the matter of food production and conservation, working through Federal and various special and advisory commissions.

SOME PRACTICAL RESULTS OF STATION WORK.

The practical results of the investigations in agronomy by the stations are evident in many ways. Much of the increased production of field and forage crops during the war was due to the stations' activities and teachings. Crops were not only more widely planted but were more intelligently cared for, so that production was materially increased, even under reduced labor conditions. The Virginia station, for example, reports that rotation studies for general farm practice, showing how a one-crop system could be changed to diversified farming, including live stock, resulted in its adoption by many farmers and is yielding noteworthy results. Efforts of the Porto Rico station were successful in securing the utilization of idle land to a greater extent, and in inducing intensive cultivation throughout the year, growing two crops upon the land at the same time, and to the use of a rotation system, including a legume, wherever possible.

The work and publications of the Alabama station on peanuts and velvet beans was largely instrumental in interesting farmers in these crops, resulting in a rapid extension in acreage. The corn crop is estimated to have been increased in that State by about 1,000,000 acres over the 1916 acreage, many farmers applying the experimental results to the crop. The New Jersey station reports that farmers are rapidly discarding their scrub varieties and using superior-yielding seed, following the station's teachings in this respect.

Varieties of cotton which the Alabama station has found most productive have been generally adopted, greatly increasing the yield. The results obtained in fertilizer experiments were the means of saving annually large sums spent in the purchase of fertilizers not required by certain soils, or needed in proportions very dissimilar to those now commonly employed.

The results of a campaign on grain sorghums by the California station were especially noticeable in the increase in acreage, the use of few rather than many varieties, and in improvement of cultural methods. The West Virginia station reports a greatly increased production of potatoes from selected seed and a more general use of proper methods of spraying for the control of potato diseases. By pointing out that the potato is not a dependable crop below an altitude of 7,500 feet in New Mexico, the station has effected a large saving of labor and money. At the beginning of the war the enthusiasm to increase food production was so great that many farmers did not stop to consider the adaptability of such crops as the potato. Through the station's advice they were induced to plant more beans, wheat, and corn.

The results of a wheat campaign participated in by the New Hampshire station showed that while the amount of wheat grown in the State in 1918 was not large, it represented an increase of over 400 per cent above what it had been in 1917. The use of pure seed wheat, as advocated by the Oklahoma station, increased the average yield to 25 bushels per acre in some sections, the average for the State being only 12.3 bushels.

The Louisiana station reports a marked effort to utilize better methods of cultivation and a more intelligent use of commercial fertilizers. The planting of legumes for lessening the requirements of nitrogenous commercial fertilizers has become much more general. This seems to be true the country over and is evidenced also by the increased use of lime and of phosphates, with a reduced use of potash.

Facts brought out in the study of soils and their plant food requirements at the North Carolina station have been widely used by the farmers in producing larger and more profitable crops. The soy bean was found to be one of the best summer-growing legumes for the State. Efforts to secure a more widespread use of this crop resulted in about a 50 per cent increase in acreage, which has aided materially in improving the producing power of many farms.

The results of the work of the stations is noticeable in animal husbandry along many lines. More interest has been manifested in well-proportioned rations for farm animals, there is a much more extensive use of roughage and silage and a greater conservation of concentrates, more extensive use of labor-saving devices in handling stock and of pure-bred sires for improving native stock.

The most noteworthy practical application of the results of the work in animal husbandry at the Wyoming station was that arising from investigations with silage and stock rations, demonstrating to ranchmen the possibility of increasing the carrying capacity of their ranges, thus adding to the total meat production of the State. The station advocated the use of such silage crops as oats, peas, or sunflowers where corn can not be grown, and as a result silos have become common in the State. The importance of providing feed for stock during the winter has been emphasized, resulting in a general use of cottonseed cake as a concentrate. Results of feeding experiments with both beef and dairy cattle with velvet beans at the Alabama station furnished a notable contribution in connection with the scarcity of dairy feeds during the war and has stimulated a demand for velvet-bean meal.

The results obtained at the Pennsylvania station in feeding cattle both for the beef and dairy herd with home-grown roughages and by-products have been put into practice, not only with marked saving but also with an increased production. This station found that the beef-breeding herd can be satisfactorily maintained during the winter

on corn silage as a sole roughage, supplemented with 3 pounds of cottonseed meal per 1,000 pounds of live weight, and throughout the summer on pasture alone. In fattening beef cattle those fed a heavy silage ration supplemented with cottonseed meal sold for a higher price on the market than cattle receiving corn in addition to a limited silage ration. With dairy cows there was found to be an advantage in supplementing the silage with hay.

The Virginia station has demonstrated methods of producing cream, butter, and cheese in parts of the State remote from shipping points and markets where it is not practicable to market whole milk, but that are well suited for pasturing dairy cattle. The results are reported to have been of value in the recent crisis.

The work on the cost of milk production by the New Jersey station was used by the United States Food Administration in determining the proper price for milk on the New York market, and was one of the guides in making up a formula for determining the cost of milk production when the prices of feed and labor are known. Similarly, the findings of the Illinois station were adopted by the Chicago milk commission and the price of milk in that city was fixed according to the data supplied.

Studies by the California station on the utilization of garbage as feed for swine as a war-emergency matter showed that many cities were destroying large amounts of this valuable hog feed. It was found in experiments that 26 pounds of "residence" garbage would produce 1 pound of live pork. This waste material has gradually been utilized until, in the city of Berkeley, Calif., alone during April, 1918, 400 tons of green garbage was collected and fed to hogs.

It is estimated that $40,000 worth of crops were saved by campaigns of the California station in locating breeding grounds of grasshoppers and by control demonstrations in the threatened districts. The station took an active part in mosquito control and sanitation of 73 camps of the Western Division of the United States Army. Similar successful grasshopper campaigns were also carried out by the Nebraska and other stations.

Investigations of bean pests by the New York Cornell station demonstrated that shallow planting and the consequent rapid breaking through the earth after germination reduced the injury done by the seed corn maggot materially. Bean growers following instructions obtained satisfactory results. Applications of the station's findings in the control of the cherry maggot by sweetened poisoned bait resulted in a good crop, although the flies emerged in large numbers from the soil. The recommendations of the Florida station that summer fallowing be employed as a measure against root knot was followed in many instances with beneficial results.

The Minnesota station developed some new insecticides, finding chloropicrin and furfurol to be highly toxic to insects and not injurious to plants or higher animals. A special application of certain new insecticides was their use against vermin in Army camps and trenches.

The annual loss in grain, forage, and timber by fire in California is estimated to be about $750,000. When war was declared there was no effective organization for the control of fires outside of the national forests and parks. Through the efforts of the California station, a forest industries committee was appointed, which actively conducted a State-wide campaign for better fire protection of the grain fields and grazing ranges.

As part of the wood-fuel campaign conducted by the New York Cornell station, emphasis was laid on the dangers of indiscriminate clearing of all forest areas and on the production of fuel wood as primarily a matter of improvement cuttings.

At the Pennsylvania station treating loblolly pine shingles with creosote resulted in their being in as good condition as western red cedar shingles after 10 years of use, which is important on account of the high cost and difficulty of obtaining the latter.

Estimates by the California station in 1917 indicated that there were 77,000 acres of young irrigated orchards that might be intercropped without injury. Beans, potatoes, and grain sorghums were advocated, resulting in an increase of from 25 to 45 per cent in the production of such crops. A campaign carried on by the West Virginia station for the destruction of red cedar trees in the vicinity of commercial orchards for the control of cedar apple rust resulted in a greatly increased fruit production.

Through the efforts of the Utah station, in one of the wheat-producing areas of the State where on a tract of 3,500 acres irrigation water was not available at the stage of growth when it is of the greatest importance, those having available water on an adjoining tract were induced to supply this for a few days, with the result that one watering increased the yield 10 bushels an acre over that produced on the unirrigated land.

The New York Cornell station reports a very general adoption of the dry method of applying formaldehyde for the control of oat smut, at a cost of less than 3 cents an acre; also extensive use in some of the onion growing regions of the formaldehyde treatment to prevent onion smut, whereby an average increased yield of nearly 50 per cent was realized.

The ruling of the United States Food Administration that the watermelon was a necessary food crop gave added impetus to the studies of the diseases of this and related crops at the Texas station. Studies of the Texas root rot by this station showed that the sweet

potato is one of the most favorable crops for carrying the causal fungus over winter.

A striking and concrete example of the application of the work of the Connecticut Storrs station to farm problems resulted from studies on pigmentation and external signs of egg-laying capacity, in the extensive culling of unprofitable fowls from flocks in the State. In 1918, 9,664 hens were examined at farm demonstrations. Of these, 3,766 were rejected. The eggs laid on the day before the culling were 2,611 from the 9,664 birds. On the day after there were 2,361 eggs from 5,898 birds, a decrease of 39 per cent of birds to be fed and only 9.5 per cent decrease in egg production. The recommendations of the New York Cornell station regarding the selection of fowls for egg production, by means of their external characters, have brought direct practical results, as shown by reports of 18,777 culled out and sent to market. The modified rations recommended by this station enabled poultry men to reduce feed costs without proportionally impairing the efficiency of the flocks. The New Jersey station demonstrated that by greatly increasing the amount of mash and decreasing the grain fed to poultry the protein in the ration was increased and more eggs were produced at less cost.

The Kansas station distributed 50,000 doses of blackleg serum during the year, which were practically 100 per cent effective. The production and distribution of hog-cholera serum which is carried on by many of the stations is rapidly bringing this disease under greater control. Tick eradication has been participated in by a majority of the stations in the South with very marked results. The saving which has resulted from the investigations of the veterinary departments of the stations has done much toward securing the increased meat production that conditions demanded.

A careful study of New Mexico weather by that station has been of value in making farming safer under local conditions. Thus, it is found that in the low altitudes of the dry-farming sections there are only a few dependable crops that can be grown successfully, such as corn, pinto beans, Kafir, milo, feterita, small grains, Sudan grass, watermelons, and pumpkins, while the nonsaccharine sorghums, pinto beans, Irish potatoes, small grains, and English peas are better adapted to the high altitudes of the dry-farming sections. In both low and high altitudes of the irrigated districts, a much larger variety of crops can be successfully raised, but in the warm irrigated valleys, the cool season crops must be started early.

At no time since the establishment of the stations have their teachings been more generally sought for, accepted, and practiced by the farmers, who have shown great interest in the work since the war situation emphasized the need for the more abundant and economical production of farm crops and live stock. Advice from the stations

has been sought on practically every subject pertaining to increased production and conservation, and the people have shown a willingness to follow the advice of technically trained men. The value of the work along investigational lines is becoming recognized as it never was before. The appeal to the farmers of the South, for example, to make that section of the country self-sustaining in the matter of food and feedstuffs has greatly aided in advancing the application of many results of the investigations of previous years.

RELATIONS OF THE STATION TO THE EXTENSION STAFF AND SERVICE.

The relation which the experiment station bears to the extension service has always been a close one, but never before have the advantages of cooperation been so evident. The emergency conditions have brought out more clearly and forcibly this mutual relation—the station as the investigating center, where the problems of agriculture are studied and to which farm difficulties are referred for solution, and the extension service as a publicity and promoting agent for the results of these investigations.

While formerly the stations, as a rule, occupied an advisory position only to the extension service, there has developed in a great many ways a much more intimate relation, the heads of the station maintaining close relations with the extension forces, and offering and receiving suggestions.

A few instances of the relationship which has developed between these two branches will serve to illustrate how this closer cooperation is working to accomplish results.

The Maine station reports that the supervision of the work of the extension service in economic entomology and in plant diseases has been under the entomologist and plant pathologist of the station, and the extension work of the Federal Forestry Service has, in its relation to the committee on fuel wood, been under the direction of the station director. In Tennessee conferences of the specialists of the extension division and the heads of the departments of the station were held, in which their work was coordinated along the lines of food conservation and production. At the Nevada station the agronomist held an important relation to the extension service in the organization and direction of the war-garden movement. The station veterinarian, working through the State live-stock commission, the veterinary control service, and the extension service, has been active in the dissemination of general information on animal diseases, similar activities being participated in by the range management department on poisonous plants of the range.

The Virginia station reports the relationship of these two branches to be very close and sympathetic, the members of the station staff

taking part in meetings initiated by the extension division and the extension workers calling attention to problems arising in the various sections of the State. The extension staff has been invaluable to the station in bringing the results of its work directly to the farmers.

The Maryland station closely associates itself with the extension staff through frequent conferences. In Utah an unusually large amount of extension work has been done by members of the station staff, through "food production" trains, special institutes, and many other activities. At the Nebraska station the heads of the technical departments are also heads of the extension work in the same lines, and are responsible for the character of the extension work in their field. Station and extension councils cooperate in discussing and recommending policies in their respective lines of work.

In Missouri the station staff was more closely affiliated with the work of the extension service during the war period than ever before, due to the fact that the station took an active part in all of the war-time campaigns, most of which were put on through the extension service. The fact that the director of the station was at the same time acting as State food administrator and chairman of the council of defense, welded together the various war activities of the State and made them all contribute to one end. In this way the station's teachings were carried much further than would have been possible without such an organization as the extension service, which was used to the fullest capacity in these various activities.

At the Illinois station the organization of the agricultural work is such that the station staff is in the closest touch with members of the extension service, and they have worked as a unit in securing results.

In Hawaii almost the entire station staff made its time and services available to render all possible assistance to the extension staff in its greatly increased opportunities for effective work.

In Montana several members of the station staff went out as emergency agents, helping in special extension campaigns for increased production and in making war aims and war needs clearly understood.

In California, when war was declared, the experiment station was immediately mobilized for war service and all members of the staff were called upon to assist in extension work and similar activity. Projects having an immediate bearing upon winning the war were exploited, not only through the activities of the extension division but also through the station workers. The most active cooperation existed between the teaching and investigational force of the institution and the extension staff. Every member recognized the emergency conditions and no effort was spared to make the work of the station a factor in assisting to meet the existing emergency.

The Louisiana station reports cordial cooperation between its staff and the extension division for the advancement of its work and policies in furnishing results of investigation, in arranging demonstrations, and in the emergency publication of press articles, circulars, and bulletins of information on timely topics.

At the Florida station the director, being also director of extension work, coordination was easily brought about.

In Arkansas the station and extension forces worked in the closest relationship. Members of the station staff frequently went out as specialists to instruct in meetings to assist county agents with sectional problems and to encourage production in particular lines and in particular sections. Joint meetings of the station staff and administrative workers of the extension force, together with specialists, were held periodically for the purpose of shaping extension policy in accordance with station teachings and war needs.

While no definite relationships were established at the New York Cornell station in regard to division work or allotment of time between the station and the extension division, they were mutually helpful to each other, and it is a fixed policy that the extension staff in undertaking any particular piece of work with farmers shall cooperate directly with the investigator especially concerned with the problem in question. Thereby the extension representative of the department is enabled to make use of the latest information in possession of the station specialist, and the latter is kept in touch with the outside work in his special line. Absence of specialists engaged in war or other Government service and increased demands for extension work required, in a number of instances, that much of the time and effort ordinarily devoted to investigation be diverted to extension activities.

The New Hampshire station reports that the war helped to bring about a much closer relationship than ever existed before between the members of the station staff, the extension force, and the public. More confidence was developed on the part of the public in established agencies and their work. The rapid development of extension activities under the stress of war served to emphasize the close relationship which must exist between the forces in the field on the one hand and the investigational work at the station on the other. The extension force is continually bringing new problems direct from the farmers to the station to be solved or explained by the trained specialist, regarding which the station is prepared to give reliable advice or assistance, meanwhile attacking new problems to meet new issues and to prepare for the future drafts which are sure to be made upon its resources of information.

The Kentucky station staff constantly advised and assisted in the campaigns conducted by the extension division, and members of the station staff acted as specialists in extension.

At the Pennsylvania station members of the staff visited the county agents and advised them concerning agricultural practices most likely to prove profitable. They have also served as judges for farm crops and exhibits of various kinds, and addressed county-agent meetings from time to time.

As the director of the Alabama station is also director of the extension service, it has been easily practicable to secure entire unity of effort between these two branches in meeting the special needs of the time. In securing this coordination and joint action, the endeavor was constantly made to avoid breaking down the lines of demarcation between research work on the one hand and extension work on the other. Emphasis was placed on the fact that as the demands for extension work increased, in much the same proportion there was increased need for enlargement and intensification of research, so that the investigators may discover the facts and formulate the conclusions for the extension workers to convey to farmers and their families.

This may be said to be the general attitude of the station and extension authorities. There is a definite recognition of the respective fields and a feeling of interdependence. These have been intensified in the past two years; but at the same time the restriction of funds to the general purposes for which they were designed has been preserved in large measure. While the examples cited do not include mention of all of the stations, in no case have the two branches failed to work in the utmost harmony and mutual helpfulness for the benefit of agriculture. The conditions have developed a closer adaptation of their work which will undoubtedly be permanent.

CHANGES IN PERSONNEL.

In regard to changes in personnel as a direct result of the war, the stations fared very differently, some losing a large number, in many instances heads of departments, while others were but slightly affected in the more important positions although practically all lost heavily among the assistants on the staff, most of these being within draft age.

In addition to the losses of the stations in resignations and leaves of absence, the fact should be mentioned that in a great many cases the director and heads of departments devoted much time to war activities, which in many instances required their absence from the station for extended periods.

Reports from some of the stations will serve to show the extent of the changes which have taken place during the year.

At the Alabama station two department heads and several assistants left the institution at the outbreak of the war, four of these entering military service and many of the others taking up lines of work more or less directly connected with the emergency demands for greater production. The director of the Arizona station was given leave of absence to engage in Government work in agriculture in Egypt.

The California station reports that the personnel of the staff was considerably altered as a result of the war. Two of the men who were in charge of investigations were given leave of absence to enter military service. Seven others who were putting part time on investigational work also entered the service, and three left for outside pursuits. Of the assistants who were directly connected with experimental work, seven entered the military service, one took up other war work, and three left for other positions. The total loss to the station was 24.

At the Colorado station 10 members of the staff were absent on war or other work for the whole or a part of the year. This fortunately included no heads of departments, the most serious loss being in the irrigation investigations, the expert in charge resigning early in the year to take up private work.

The Connecticut Storrs station reports but few changes, and not all of these due to war conditions. The dairy department lost two men, the agronomy department, one.

While the changes in personnel at the Delaware station were numerous only one department head resigned. A great many of the assistants went directly or indirectly into war work. The Florida station suffered very little from losses in its staff aside from some of the assistants. The Hawaii station reports the loss of four or five assistants only, by reason of the war. There were 18 resignations from the Indiana station, including 1 chief and 3 associates.

At the Illinois station the vice director and head of the agronomy department was on leave of absence as head of the agricultural division of the Red Cross commission to Greece; the head of the division of swine husbandry left to take charge of the emergency pork production campaign; the associate in animal husbandry was released for temporary appointment to assist the United States Department of Agriculture in investigations into the cost of producing live stock; and another associate to take charge of emergency work of the Bureau of Animal Industry of the United States Department of Agriculture in connection with the boys' and girls' pig clubs. Aside from these changes the station lost for military service one chief of department, one associate, and 24 assistants.

The changes in personnel at the Iowa station included 11 resignations and 20 leaves of absence, mostly for war work. At the Kansas station there were 18 resignations which took effect during the year. These included no department heads except the director of the station who resigned to accept the presidency of the college. The resignations included two superintendents of branch stations.

One department head in the Kentucky station resigned to accept another position and 10 members of the staff entered military service. Three assistants left to accept other positions. In the Louisiana station there were five changes in the heads of departments during the year. Among the assistants, one resigned for other work and six for military service.

In addition to several changes in minor positions at the Maine station, two biologists, three of their assistants, and one chemist were called into Government work in the United States Food Administration. The changes at the Maryland station included three important head positions and four assistants. At the Massachusetts station, one department head, one associate, and six assistants entered military service, two assistants leaving for other positions. There were 25 resignations from the Michigan station.

Members of the staff of the Minnesota station resigning or on leave of absence to enter Government service in a civilian capacity in connection with the various war propaganda included an associate agronomist, who went to Serbia as agricultural advisor in reconstruction work, and the head of the agricultural division who also went to Serbia with the Red Cross Serbian Relief Mission. The associate entomologist devoted his entire time to work for the Council of National Defense in investigations in connection with body lice. In addition to these, the changes include the entrance into military service of two heads of departments, two associate heads, and about 20 assistants. The Mississippi station was fortunate in not losing any heads of departments, but work in animal husbandry was seriously handicapped by losing nine foremen, five of them going into military service.

One head of department at the Missouri station left to engage in military service and 19 assistants either resigned or were given leave of absence for this purpose. Several members of the staff of the Montana station were engaged in various activities growing out of the war, but all were expected back and no serious interruption of the work occurred. The changes in personnel at the Nebraska station include about 24 men, of whom one head of department was granted leave of absence and one resigned. Two associate heads and eight assistants were given leave of absence. Twelve other assistants resigned. A number of assistants and one head of department were lost by the Nevada station.

The New Hampshire station lost the station chemist for war work, two assistants left for military service, and three for other positions. The New Mexico station reports very few changes in the personnel. Statistics of the New York Cornell station show a total loss of 29 from the investigational staff, 25 to enter Government service and 4 for positions elsewhere. Seventeen of these were assistants. No heads of departments left the station.

The Oklahoma station, besides undergoing a change in director, lost several heads of department. Three men went into military service and about eight resigned for other positions. At the Pennsylvania station there were 15 resignations from the staff and 13 leaves of absence for a whole or part of the year, among which 11 entered military service. One head of department and one associate were granted leave of absence. The Rhode Island station was depleted among the younger assistants only.

At the South Carolina station not a man below the age of 31 was left on the staff. Eleven went into military service and three into agricultural work connected with food production. Three division chiefs were lost, one to take another position, one for war work, and one retired.

At the South Dakota station, although none of the heads of departments left on account of the war, a considerable number of changes took place in the personnel. In the dairy department three different chemists were appointed and all left for military service. The associate agronomist entered the Army; also the chemist in charge of the sugar beet investigations. Several assistants resigned for military duty. Losses in personnel during the period of the war at the Tennessee station were not great. Two assistant chemists and one field assistant left. The most serious difficulty was in getting labor to carry on the experimental work.

Most of the members of the staff of the Utah station were able to continue their connection with the institution in spite of war work. The head of the department of animal husbandry was commissioned a captain in the Sanitary Corps of the United States Army. Two regular assistants and several student assistants went into the military service, four leaving for other lines of work. There were relatively few changes at the Virginia station during the year, no department heads or key men being lost. Three associates left or were granted leave of absence, two for military service and one for another position.

There was a change in the directorship of the Arizona, Indiana, Kansas, Kentucky, North Dakota, Oklahoma, and Wyoming stations.

Never since the stations were established has there been anything like the number of changes in personnel. These changes were largely

due to the war demands or to opportunities opened up by it. The industries drew a considerable number of workers from the stations by the larger salaries they were able to hold out. In addition there was the usual amount of shifting from one institution to another, which seems inevitable as long as such differences exist between them in opportunity and other attractive features.

FILLING VACANCIES—EMPLOYMENT OF WOMEN.

Many of the positions that were vacated on account of the war were purposely held open for the return of the persons previously holding them. Some of these vacancies, however, required new appointments in order to keep the investigations going. The demand for trained scientific men capable of carrying on such work soon became greater than the available supply, and many stations had difficulty or were unsuccessful in securing men to fill these positions. To a limited extent this deficiency was supplied by the appointment of women. A few stations report success in filling all vacancies. The following brief reports from some of the stations will indicate how far it was possible to meet these conditions:

Filling vacancies in the California station was postponed in most cases until the close of the war. One woman was employed to conduct investigations which would otherwise have been delayed. The Colorado station found difficulty in filling vacancies satisfactorily. Two women were employed, one in bacteriology and one in home-economics investigations. Vacancies in the Connecticut State station were not filled, but the remaining staff was called upon for much extra work.

At the Delaware station some vacancies remained unfilled at the close of the year. Difficulty was found in finding women properly trained for the work. One was found qualified to do the chemical work of the station and was appointed.

Efforts to fill scientific positions at the Florida station with women workers was successful as far as the quality of the work was concerned, but difficulty was experienced in getting applicants. Considerable difficulty was found in filling vacancies at the Hawaii station, inasmuch as most of the positions were not such as to make it possible to fill them with women employees. Idaho station had difficulty in filling vacancies. One woman was employed in the chemical laboratory. In only one case was it necessary to employ a woman to fill the place of a staff member at the Indiana station, and the result was very satisfactory.

Vacancies in the personnel of the Kentucky station generally remained unfilled until the close of the war, as it was found extremely

difficult to secure men of the necessary training, and the policy was adopted of holding the positions open for all those who left to engage in military service. Women were used to a slight extent as substitutes, but none were regularly appointed during the year. The Louisiana station was unable to fill all the vacancies. No women were employed, as none could be found with the required technical training.

The Maine station reports that as the men leaving were granted leave of absence during the period of the war no attempt was made to permanently fill their places. No great difficulty was found in getting the expert help needed. The greatest difficulty was in securing young men as assistant chemists. This station has always employed women rather freely, but the proportion of women on the staff was increased during the war. Women were employed to fill the vacancies in the seed laboratory of the Maryland station entirely, and also in some other laboratories to give temporary assistance. At the Massachusetts station one woman assistant was engaged for the year in chemistry, and two others were employed during the summer months, one in chemistry and one in microbiology. At the Michigan station vacancies were only partly filled. Women were employed as assistants, and were satisfactory. It was not found possible to replace station workers with women at the Minnesota station, except in a few instances as laboratory assistants.

At the Mississippi station women took the place of men in all offices and did considerable work that was formerly done by men. Great difficulty was encountered in filling vacancies at the Missouri station, especially with younger men. This resulted in a decreased station staff during the period of the war, as few of the places made vacant by the men going into military service were filled. Some use was made of women, three or four having been added to the station staff during the war period, all of them in the capacity of assistants.

At the Montana station deficiencies were made up largely by adjustments between the college and the station. Women students were used rather than men as temporary assistants in some departments. Most of the men entering the Army from the Nebraska station received leave of absence during the war, and consequently in about half the cases it was impossible to fill their places, due to the fact that the positions were temporary and men were difficult to secure. Women were used in increasing numbers to fill clerical positions. One woman was employed in plant pathology and one temporarily for chemical analysis. The Nevada station had no difficulty in filling vacancies. Reports from the New Hampshire station show difficulty in finding men to replace those leaving, and conse-

quently to carry on some of the regular station activities. It was somewhat hard to fill vacancies at the New Mexico station, some still remaining open at the close of the year. The problem was a very acute one at the New Jersey station, and some vacancies remained unfilled. One woman was appointed in the plant pathology department, largely for laboratory work, and a number successfully filled positions in the Vineland egg-laying contest.

The New York Cornell station found it impossible to fill vacancies with adequately trained men in the majority of cases; accordingly considerable adjustment of the work of the staffs of the departments was necessary. While a few women were employed to fill vacancies, the extent of this practice was negligible. The New York State station was unable to fill any vacancies. Men were not available, especially at the salaries it was possible to offer them. No women were employed in the scientific departments, although they would have been taken on in certain positions could competent ones have been found.

Great difficulty was encountered in filling positions at the North Dakota station, especially in chemistry. Women were employed in the biological laboratory and also for field and garden work.

At the Ohio station it was found that the general advance in wages and salaries made it impossible to continue the work on the scale in operation before the war, consequently some of the positions were not filled. The Oklahoma station was not able to secure men for certain positions, chemists being very difficult to obtain and agricultural engineers seemed impossible to find. Other departments also found much difficulty in securing properly trained men. Women were not employed to any extent outside of the clerical force, owing, mainly, to the fact that those with proper training for the scientific branches could not be found. Women were employed to a limited extent in farm work, which was formerly done by men alone. The Pennsylvania station experienced great difficulty in filling positions, as did also the Rhode Island station. Attempts of the latter institution to secure young women for analytical chemical work were unsuccessful.

The South Carolina station employed two women as research workers on the staff. The field work and experiments were seriously interfered with on account of labor shortage. Reports from the South Dakota station indicate very poor success in filling vacancies. Three women were employed on the staff, but it was very difficult to find candidates properly trained for the work. All of the assistance in the bacteriological department at the Tennessee station was given by women during the greater part of the year. At the Texas station the vacancies created by men leaving for war service were

for the most part filled with women workers, although great difficulty was encountered in finding women properly trained for scientific work.

No serious attempt was made to fill vacancies at the West Virginia station, which adopted the policy of holding these open until the men returned or of delaying appointments until conditions were such that more applicants would be available. The Wyoming station reports great difficulty in securing competent men to fill vacancies, particularly with regard to laborers on the farms.

It will be seen that of the large number of vacancies which occurred many were left open to those who might return from the war, or remained unfilled because of the extreme difficulty in securing competently trained persons who could step into important positions. The competition between institutions and with the industries was unusually keen.

Women were employed for certain classes of work to a considerable extent, and apparently with quite general satisfaction. Their assistance enabled lines of work to be actively maintained which otherwise would have had to lapse for the time being. But here also the number available was limited. If a permanent field for women should develop in the station work, doubtless a considerable number would make special preparation for it.

While many of those who went into war work will return, many others will not, and on account of competition and the limited funds of most of the stations the question of maintaining an efficient and adequate personnel is a serious one.

STATION FUNDS.

In addition to the Federal funds arising from the Hatch and Adams Acts, $15,000 under each to each State, the stations had as other sources of revenue appropriations from the States, fees for inspection or other service, and funds resulting from the sale of products incidental to their operation, aggregating during the year covered by this report upward of $4,620,000. The total direct appropriations from the States, or the assignments made from the colleges to the stations, aggregated $2,710,205.36. The fees were for the conduct of various lines of control work, and the farm sales represented a turnover of funds rather than source of additional revenue for investigation. The size of the latter is due to the fact that some of the stations operate the college farms or large tracts placed in their charge. Miscellaneous funds include balances and unclassified revenues. The Federal funds and direct State appropriations constitute, therefore, the principal source of revenue for maintenance and investigation. The Federal appropriations to the State stations

amounted, after taking account of slight balances, to $1,439,895, and for the support of the insular stations to $155,000. The total revenue of the State and insular stations was $6,215,681. (For details, see Statistics, pp. 72, 73.)

It is encouraging to note that the State support of the stations is gradually increasing. A liberal support means largely increased usefulness and a resulting increase in the agricultural prosperity of the State.

The State appropriations may be made to the stations directly, or carried in the general appropriations to the respective colleges and assigned to the stations. In many instances much of the State appropriations is for definite purposes and can not be used for general investigation or for station maintenance. Those stations which include control work in their activities receive either direct appropriation for the support of this kind of work or it is supported by the fees collected. In several of the States appropriations are made for the support of substations.

Attention is here called to some of the funds derived by stations from State and other sources:

The Alabama station received an appropriation of $27,000 from the State for local experiments, $5,000 of which was used for extension purposes. For the central station, at Auburn, there has been no increase of support since the Adams fund became available in 1906. State funds for local experiments in the various counties are not available for use at the central station. The station has felt this lack of support severely, especially as the cost of fertilizers, labor, and apparatus and other material has increased two to three fold.

The California station received State appropriations amounting to about $115,000, approximately one-half of its total resources.

In addition to State appropriations and other funds, the Connecticut State station, at New Haven, had the benefit of an income from a legacy, which the past year amounted to nearly $14,000.

State appropriations used specifically for experiment and research at the Illinois station included $31,000 for live-stock investigations, $18,500 for crop investigations, $96,000 for soil investigations, $21,000 for horticultural investigations, $21,000 for dairy work, and $8,000 for floricultural studies, giving a total of $195,500, with a sales fund of over $67,000.

The Indiana station received from the State a total of $91,000 for various purposes, including, among other lines, work in horticulture, dairying, poultry husbandry, animal diseases, and soils and crop improvement.

The income of the Iowa station from the State included $115,500 for maintenance, $25,700 for soil-survey work, and $10,000 for the

Patten fruit-breeding farm at Charles City. The sales funds amounted to nearly $60,000.

State appropriations for the Kansas station amounted to $59,500, with a sales fund of over $50,000.

The income of the Kentucky station, in addition to the Federal funds, was about $217,000, which included, in round numbers, over $80,000 direct State appropriations, nearly $91,000 from inspection and serum work, about $21,000 from sales, and about $23,000 from miscellaneous sources.

The total State appropriations for the Maryland station were nearly $50,000, which included over $6,500 for the Ridgely farm (branch station).

The Massachusetts station received $46,000 State aid, $13,500 from miscellaneous receipts, and nearly $10,000 from farm sales. Two thousand dollars of the State appropriations were for buildings and equipment.

Receipts at the Michigan station from the State were nearly $57,000, of which over $7,000 was appropriated for the branch stations.

The total supplementary income of the Minnesota station was approximately $273,000, which included over $185,000 direct State appropriation and $87,000 from sales.

The Missouri station had an income of over $90,000, in addition to the Federal funds, including special appropriations for soil survey and other purposes. The sales fund was nearly $24,000.

State appropriations to the Montana station amounted to over $96,500, some of it for special purposes. The substations received nearly $30,000 for maintenance.

The income of the Nebraska station included special and other appropriations from the State amounting to $38,500, and about $50,000 for the branch stations. The sales funds were over $100,000.

The New Jersey stations received a total State appropriation of $103,500, divided among the various departments and for special purposes, supplemented by about $57,500 from sales, fees, and the issue of licenses.

In New York the Cornell and State stations share in the Federal funds, the former receiving $27,000, the latter $3,000. At the Cornell station this is supplemented, as required, by funds from the college of agriculture. The State station received over $136,600 from the State.

The North Carolina station received an income of nearly $70,000 from the State, in addition to a sales fund of over $8,000. The branch stations were supported by an appropriation of over $38,800.

The total income of the North Dakota station, in addition to the Federal funds, was over $88,000, including nearly $37,000 for the substations.

The supplementary income of the Ohio station was over $302,500 from the State and a sales fund of nearly $52,700.

The total income of the Oregon station, aside from the Federal funds, was about $77,000, over $13,000 being from sales, the balance from State and other sources.

The Texas station received a State appropriation of over $230,800, including over $40,000 for the maintenance of the substations. The farm sales amounted to more than $40,000.

The income for the Washington station was about $58,000 from the State, supplemented by nearly $20,000 from sales.

The West Virginia station received about $35,000 for current expenses, $10,000 as an emergency fund, $10,000 for farm buildings and improvements from the State, and about $15,000 from sales.

The supplementary fund received from the State by the Wisconsin station was $95,000.

The stations receiving the largest aid from State and other sources, exclusive of the Federal funds, were, in round numbers, as follows: Ohio, $384,000; Indiana, $378,000; Illinois, $286,000; Texas, $274,000; Minnesota, $273,000; Nebraska, $242,000; Kentucky, $217,000. The California, Iowa, Kansas, Missouri, Montana, New Jersey, New York State, and North Carolina stations each received over $100,000.

As in previous years some half-dozen stations received no regular appropriation from the States, although a number of them had State aid in the form of printing and other provisions which serve to supplement the Federal appropriations.

NEW BUILDINGS AND EQUIPMENT.

The high cost of material and labor limited the additions to buildings and equipment to a minimum. The stations making such improvements during the year were as follows:

At the Arizona station about $8,800 was spent for improvement and equipment.

At the Arkansas station two small barns were built. Additions to the live stock included 6 purebred beef cattle, 9 purebred dairy cattle, several purebred hogs, 20 head of grade beef cattle, and 4 head of work stock. A small amount of machinery and a limited amount of apparatus for technical work was added to the station equipment.

The station buildings at the citrus experiment station at Riverside, Calif., were completed and dedicated during the year. At the Colo-

rado station $10,293.84 was expended under the heading of "buildings and land" from State funds, for various improvements, including $689.90 from a special appropriation for drainage and $548.67 from a special appropriation for a seed laboratory. A central heating plant with an 88-horsepower boiler, was built at the Connecticut State station with an appropriation of $28,000 from the State. During the year the Delaware station moved into the newly completed agricultural building, "Wolf Hall."

The equipment of the pathological division of the Hawaii station was materially increased, and a hot-air food and vegetable drier installed.

The Idaho station added a horse barn costing $10,000, a sheep barn costing $4,000, a swine barn costing $3,000, a small dairy building, fencing and tiling costing about $1,500, and machinery and general equipment to the extent of about $1,500. At the Caldwell substation in Idaho, a helper's cottage, machine shed, milk house, and other improvements were made costing about $1,000.

At the Indiana station the annex was remodeled adding 3,500 square feet of office space for extension offices. A new house was built on the Wilson farm and a new house and packing shed on the Moses Fell annex. A new farm of 120 acres was purchased, to be used for a dairy production farm, and a new experimental field of 20 acres was secured in Huntington County for soil improvement experiments.

The Iowa Legislature appropriated $75,000 for the purchase and equipment of a farm for the use of the animal husbandry department. A new dairy barn and silos, costing $20,000 was completed, equipped with all modern conveniences, and a workman's duplex cottage was built at a cost of about $5,500. The new animal husbandry meat laboratory is one of the most complete buildings of its kind in the country. It is 74 by 112 feet in size and cost, with equipment, about $6,000.

A new stock-feeding shed, costing about $4,000, was constructed during the year at the Kansas station to replace one destroyed by fire. An addition to the Louisiana station was a new swine barn at the Calhoun station, costing about $600. A silo and liquid manure pit were added at the Michigan station. The Mississippi station added two new barns, one for breeding work and one for taking care of mule colts. The steer-feeding shed was enlarged to twice its original capacity and a barn was built for the beef bulls. Rather large increases were made in equipment at the Missouri station, shared in by all departments.

A new fireproof chemical building at the Montana agricultural college, which will cost with furniture and equipment in the neighborhood of $140,000, was nearly completed. About one-sixth of this

building will be used by the experiment station. Additions were made to the grain laboratory costing $3,200, and new buildings for the agricultural engineering department were built at a cost of $1,800.

At the Nebraska station the agricultural engineering hall was about completed, costing $160,000. An agronomy farm of 160 acres at Lincoln was purchased at a cost of $3,600, and about $6,000 expended in building a farm residence on it. A fruit farm of 60 acres at Union was purchased for $10,000.

Through the cooperation of the university of Nevada, the floor space occupied by the station in the college buildings was nearly doubled, making it possible to equip new laboratories for the study of animal diseases and range plants. A new agricultural building to cost about $60,000 was nearly completed.

The New Hampshire college and station derived unexpected benefit as a result of having a vocational training department located at the college. Several buildings that the institution was badly in need of were erected. A new, model poultry plant was built, which made a valuable addition to the equipment and facilities of the poultry department. A new and up-to-date piggery, furnishing accommodations for work in pork production, and a wagon and machinery shed and shop were constructed for the farm department.

At the New Mexico station, poultry buildings and dairy, beef cattle, sheep, hog, and horse barns were built with State funds, to be used in part for experimental stock. The State provided funds at the New York Cornell station for a new insectary building. Small additions were made to the thrashing shed and storage room of the department of plant breeding. Special equipment for conditional control studies have been purchased by the department of plant pathology. At the New York State station a new administration building was completed during the year, for administrative and other uses, costing approximately $100,000. At the North Carolina station a laborers' house, costing $1,100, was constructed on the farm and a $400 addition to the poultry house completed.

About $2,000 was expended for apparatus and implements and $1,300 for stock at the North Dakota station. The Ohio station greenhouses were being rebuilt at a cost of $12,000.

At the Oklahoma station a new science hall, to cost approximately $100,000, was begun. A contract was let for building a cold frame and semigreenhouse. A fruit products building, one of the most extensive and complete of its kind in the country, was erected at the Oregon station at a cost of $1,400, exclusive of equipment. Two experimental silos were built at the Pennsylvania station during the year with a capacity of about 30 tons each, and considerable apparatus was secured for the chemical bacteriological and field laboratories. The South Carolina station constructed a gin house and

installed a gin at the Pee Dee station, costing about $1,200, and a tractor and truck were purchased for the substations. A small addition was made to the dairy barn at the South Dakota station. The Tennessee station erected three new barns on the Cherokee Tract and one at the New Middle Tennessee station at Columbia. The new building for the Texas station was nearly completed. A new veterinary building was occupied and a new field laboratory and an experimental barn for Texas fever investigations was erected.

A new live-stock building was completed at the Utah station, to be occupied by the departments of animal husbandry, dairying, poultry, and veterinary science. There was, in course of construction, an irrigation and a plant-industry building. The station added materially to its equipment in various lines. At the West Virginia station a new agricultural building and barns were under construction.

At the Wyoming station a new hog house, costing about $3,500, was in course of construction. A 10–20 tractor, with plows, and a small thrashing machine were added to the farm equipment. The station farm at Lander, owned by the agricultural college and leased for the past 10 years to the Horticultural Society, was taken over by the college, to be used in cooperation with the society as a substation, on which both agronomy and animal husbandry investigations will be carried on, the horticultural work being also continued. This, it is hoped, will be the beginning of a substation movement.

NEW LEGISLATION AFFECTING STATION WORK.

In a majority of the States either no legislative session was held during the year or no legislation affecting the station was enacted. Such action as was taken was as follows:

In Kentucky, the food and drug work, formerly done by the experiment station, was transferred to the State board of health. The act provides, however, that the experiment station shall be paid $18,000 a year, for which it is required to carry on the analytical work for the board of health. An act providing for the licensing of creameries and of testers became effective July 1, 1918. This law will be self-supporting so far as it is enforced by the experiment station, the income from it being estimated at about $3,000.

In Louisiana, the director of the station was chairman of a legislative committee, appointed by a State-wide meeting of Louisiana farmers, to aid in securing legislation asked by the farmers' convention for considering legislative matters.

In Massachusetts, the fertilizer law was amended to require a tax of 6 cents per ton in addition to the license fees on brands.

In Virginia, the 1918 session of the general assembly increased by $4,000 the appropriation for county station work, thereby making

$20,000 available for this purpose annually, beginning March 1, 1918. In addition, $10,000 was appropriated annually for research and experiments at the main station under the provisions of a law passed in 1906, but inoperative since 1908. The State board of agriculture increased its appropriation by $750, thereby making $7,500 available for experiments at the county stations which are supported by that board.

STATISTICS OF THE STATIONS.

During the fiscal year ended June 30, 1918, the total income of the experiment stations, including the stations in Alaska, Hawaii, Porto Rico, and Guam, was $6,215,681.65. Of this amount $719,896.54 was derived under the Hatch Act, $719,999.84 under the Adams Act, $155,000 from the Federal appropriations for the insular stations, $2,716,205.36 from State appropriations, $17,815.40 from individuals and communities, $216,686.47 from fees, $918,466.34 from the sale of products, and $751,508.08 from miscellaneous sources.

The value of additions to the equipment of the stations during the year was estimated to be as follows:

Buildings	$417,053.24
Library	17,361.09
Apparatus	44,732.03
Farm implements	97,649.59
Live stock	153,310.28
Miscellaneous	176,446.15
Total	906,552.38

The stations employed 1,684 persons in the work of administration and inquiry. Of this number, 897 were also members of the teaching staff of the colleges, and 449 assisted in the various lines of extension work. During the year the stations published 796 annual reports, bulletins, and circulars, aggregating 21,954 pages, and these were distributed to 1,030,105 addresses on the regular mailing list.

The statistics of the stations by States are given in detail in the tables following:

Station.	Location.	Director.	Date of original organization.	Date of organization under Hatch Act.	Number on staff.	Number of teachers on staff.	Number of persons on staff who assist in extension work.	Publications during fiscal year 1917–18.		Number of names on mailing list.
								Number.	Pages	
Alabama (College)	Auburn	J. F. Duggar	Feb. —,1883	Feb. 24,1888	18	12	20	6	352	28,000
Alabama (Canebrake)	Uniontown	J. M. Burgess	Jan. 1,1886	Apr. 1,1888						
Alabama	Tuskegee Institute	G. W. Carver	Feb. 15,1897		15					
Alaska	Sitka	C. C. Georgeson			7			1	91	4,000
Arizona	Tucson	R. H. Forbes		1889	13	11	10	15	344	12,000
Arkansas	Fayetteville	Martin Nelson		1887	17	17	13	68	522	40,000
California	Berkeley	T. F. Hunt	1875	Mar. —,1888	95	90	71	67	1,187	35,437
Colorado	Fort Collins	C. P. Gillette		Feb. 29,1888	34	21	8	6	188	10,598
Connecticut (State)	New Haven	E. H. Jenkins	Oct. 1,1875	May 18,1887	20	1	6	5	574	9,400
Connecticut (Storrs)	Storrs	do		do	12	6	8	6	321	13,000
Delaware	Newark	Harry Hayward		Feb. 21,1888	13	7		2	78	5,000
Florida	Gainesville	P. H. Rolfs		1888	11	1	8	24	407	15,000
Georgia	Experiment	J. D. Price	Feb. 18,1888	July 1,1889	6					11,500
Guam	Guam	C. W. Edwards			3			1	58	
Hawaii	Honolulu	J. M. Westgate			17		8	9	192	4,000
Idaho	Moscow	J. S. Jones		Feb. 26,1892	21	15	10	14	410	12,067
Illinois	Urbana	Eugene Davenport		Mar. 21,1888	92	67	35	38	912	42,000
Indiana	Lafayette	C. G. Woodbury	1885	Jan. —,1888	49	12	6	54	917	23,000
Iowa	Ames	C. F. Curtiss		Feb. 17,1888	52	14		40	676	34,534
Kansas	Manhattan	W. M. Jardine		Feb. 8,1888	64	26	64	15	522	22,000
Kentucky	Lexington	T. P. Cooper	Sept. —,1885	Apr. —,1888	42	17	9	17	589	20,000
Louisiana (Sugar)	New Orleans		do							
Louisiana (State)	Baton Rouge	W. R. Dodson	Apr. —,1886		21	2	4	5	215	7,500
Louisiana (North)	Calhoun		May —,1887							
Maine	Orono	C. D. Woods	Mar. —,1885	Oct. 1,1887	18			21	618	19,650
Maryland	College Park	H. J. Patterson	1888	Apr. —,1888	24	2		11	293	20,000
Massachusetts	Amherst	W. P. Brooks	1882[1]	Mar. 2,1888	40	16		25	606	26,139
Michigan	East Lansing	R. S. Shaw		Feb. 26,1888	35	21		20	1,341	45,000
Minnesota	University farm	R. W. Thatcher	Mar. 7,1885	1888	73	65		15	520	9,300
Mississippi	Agricultural College	E. R. Lloyd		Jan. 27,1888	17	7	1	8	240	20,000
Missouri (College)	Columbia	F. B. Mumford		Jan. —,1888	47	46	1	10	399	13,798
Missouri (Fruit)	Mountain Grove	Paul Evans	Feb. 1,1900		5					
Montana	Bozeman	F. B. Linfield		July 1,1893	22	14	9	26	465	13,025
Nebraska	Lincoln	E. A. Burnett	Dec. 16,1884	June 13,1887	25	14	3	11	502	9,254
Nevada	Reno	S. B. Doten		Dec. —,1887	14		1	7	186	3,500
New Hampshire	Durham	J. C. Kendall	1886	Aug. 4,1887	16	14	13	11	253	21,000
New Jersey (State)	New Brunswick	J. G. Lipman	Mar. 10,1880		31	22	15	36	1,472	8,500
New Jersey (College)	do	do		Apr. 26,1888	16	6				
New Mexico	Agricultural College	Fabian Garcia		Dec. 14,1889	17	17	7	8	395	12,000

New York (State)	Geneva	W. H. Jordan	Mar. —, 1882		36			3	754	48,727
New York (Cornell)	Ithaca	A. R. Mann	1879	Apr. —, 1888	46	46		14	658	9,000
North Carolina (College)	West Raleigh	B. W. Kilgore	Mar. 12, 1877	Mar. 7, 1887	42	6	6	4	142	64,900
North Dakota	Agricultural College	L. Van Es [2]		Mar. —, 1890	27	6	11	7	268	5,500
Ohio	Wooster	C. E. Thorne	Apr. 25, 1882	Apr. 2, 1888	58	3	7	22	1,008	66,000
Oklahoma	Stillwater	H. G. Knight		Dec. 25, 1890	20	15		2	54	13,000
Oregon	Corvallis	A. B. Cordley		July —, 1888	36	28	23	9	382	2,250
Pennsylvania	State College	R. L. Watts		June 30, 1887	60	50	60	8	194	35,000
Pennsylvania (Nutrition)	do	H. P. Armsby	1907		6			3	52	52
Porto Rico	Mayaguez	D. W. May			11		2	7	227	3,058
Rhode Island	Kingston	B. L. Hartwell		July 30, 1888	9	2		4	106	1,800
South Carolina	Clemson College	H. W. Barre		Jan. —, 1888	18	12	12	9	188	5,000
South Dakota	Brookings	J. W. Wilson		Mar. 13, 1887	13	2		4	106	1,800
Tennessee	Knoxville	H. A. Morgan	June 8, 1882	Aug. 4, 1887	22	5		2	35	10,000
Texas	College Station	B. Youngblood		Apr. 3, 1889	35	3	1	21	872	40,936
Utah	Logan	F. S. Harris		1890	22	30	15	12	305	8,000
Vermont	Burlington	J. L. Hills	Nov. 24, 1886	Feb. 28, 1888	15	7	3	4	136	14,000
Virginia	Blacksburg	A. W. Drinkard, jr	1888	1891	25	10	1	18	343	12,000
Virginia (Truck)	Norfolk	T. C. Johnson			3			4	94	6,500
Washington	Pullman	George Severance [2]		1891	29	10	9	6	89	28,705
West Virginia	Morgantown	J. L. Coulter		June 11, 1888	29	17	18	9	198	16,000
Wisconsin	Madison	H. L. Russell	1883	1887	87	56	43	14	530	33,375
Wyoming	Laramie	A. D. Faville		Mar. 1, 1891	13	12	6	5	119	15,000
Total					1,684	897	449	796	21,954	1,030,105

[1] In 1882 the State organized a station here and maintained it until June 18, 1895, when it was combined with the Hatch Station at the same place.
[2] Acting director.

Revenues and additions

	Station.	Federal.		State.	Individuals and communities.	Fees.	Farm products.	Miscellaneous.[1]
		Hatch fund.	Adams fund.					
1	Alabama (College)..	$15,000.00	$15,000.00	$27,000.00	.....	.....	$364.70	$4,262.60
2	Alaska.....	.....	.....	.....	.....	.....	.....	.....
3	Arizona.....	15,000.00	15,000.00	41,221.31	.....	.....	18,949.47	2,355.00
4	Arkansas.....	15,000.00	15,000.00	40,293.50	$1,769.87	$1,280.73	11,187.00	3,211.44
5	California.....	15,000.00	15,000.00	114,037.81	.....	6,965.05	50,363.40	11,931.63
6	Colorado.....	15,000.00	15,000.00	51,002.61	.....	.....	9,500.11	17,984.12
7	Connecticut (State)	7,500.00	7,500.00	26,437.50	13,900.33	12,300.00	.....	1,747.51
8	Connecticut (Storrs)	7,500.00	7,500.00	7,500.00	.....	.....	.....	8,523.08
9	Delaware.....	15,000.00	15,000.00	10,000.00	.....	.....	23,773.30	.....
10	Florida.....	15,000.00	15,000.00	9,241.65	.....	.....	8,082.78	3,319.26
11	Georgia.....	[3]15,000.00	[3]15,000.00	519.63	.....	.....	4,902.54	1,696.68
12	Guam.....	.....	.....	.....	.....	.....	.....	.....
13	Hawaii.....	.....	.....	[4]3,600.00	20.20	.....	.....	950.91
14	Idaho.....	15,000.00	15,000.00	.....	.....	.....	2,456.55	1,581.58
15	Illinois.....	15,000.00	15,000.00	195,500.00	.....	.....	67,053.93	23,796.05
16	Indiana.....	15,000.00	15,000.00	91,000.00	.....	.....	.....	287,770.04
17	Iowa.....	15,000.00	15,000.00	115,505.78	.....	.....	59,545.59	13,692.18
18	Kansas.....	15,000.00	15,000.00	59,500.00	.....	.....	45,767.03	32,872.59
19	Kentucky.....	15,000.00	15,000.00	80,643.38	.....	91,882.74	21,430.20	23,812.26
20	Louisiana.....	15,000.00	15,000.00	.....	.....	.....	.....	37,946.16
21	Maine.....	15,000.00	15,000.00	16,190.95	.....	11,884.92	16,393.30	59.97
22	Maryland.....	15,000.00	15,000.00	49,114.49	.....	.....	15,732.03	13,402.24
23	Massachusetts.....	15,000.00	15,000.00	46,000.00	.....	7,412.60	9,931.75	29,346.49
24	Michigan.....	15,000.00	15,000.00	36,861.60	.....	15,115.00	7,328.60	273.09
25	Minnesota.....	[5]15,000.00	15,000.00	185,757.91	.....	.....	87,014.05	306.34
26	Mississippi.....	15,000.00	15,000.00	27,250.00	.....	271.00	22,819.09	6,169.29
27	Missouri (College)...	15,000.00	15,000.00	22,998.70	.....	31,776.11	23,887.87	29,288.18
28	Montana.....	15,000.00	15,000.00	96,540.48	.....	.....	17,381.79	.....
29	Nebraska.....	15,000.00	15,000.00	81,615.00	.....	.....	108,639.52	52,289.12
30	Nevada.....	15,000.00	15,000.00	.....	.....	.....	1,046.37	2,594.56
31	New Hampshire....	15,000.00	15,000.00	.....	.....	.....	764.11	10,284.62
32	New Jersey (State).	.....	.....	103,500.00	.....	36,128.32	21,349.15	.....
33	New Jersey (College)	15,000.00	15,000.00	.....	.....	.....	.....	.....
34	New Mexico.....	15,000.00	15,000.00	7,022.72	125.00	.....	3,650.70	15,965.28
35	New York (State)..	[5,3]1,500.00	[5,3]1,500.00	136,676.40	.....	.....	.....	2,593.88
36	New York (Cornell)	13,500.00	13,500.00	.....	.....	.....	.....	.....
37	North Carolina (College).....	15,000.00	15,000.00	108,017.00	.....	.....	8,087.03	839.00
38	North Dakota.....	[3]15,000.00	[3]15,000.00	49,680.21	.....	.....	38,373.88	5,660.69
39	Ohio.....	15,000.00	15,000.00	302,530.00	.....	.....	52,694.45	29,012.44
40	Oklahoma.....	15,000.00	15,000.00	4,496.41	.....	.....	4,550.81	4,943.93
41	Oregon.....	15,000.00	15,000.00	43,000.00	2,000.00	.....	13,263.44	18,738.23
42	Pennsylvania.....	15,000.00	15,000.00	5,000.00	.....	1,670.00	35,697.72	247.45
43	Pennsylvania (Nutrition).....	.....	.....	.....	.....	.....	.....	.....
44	Porto Rico.....	.....	.....	.....	.....	.....	.....	.....
45	Rhode Island.....	15,000.00	15,000.00	.....	.....	.....	.....	7,815.94
46	South Carolina.....	15,000.00	15,000.00	.....	.....	.....	2,839.78	12,882.35
47	South Dakota.....	15,000.00	15,000.00	16,000.00	.....	.....	1,962.41	14,433.71
48	Tennessee.....	15,000.00	15,000.00	24,072.15	.....	.....	9,836.16	991.77
49	Texas.....	15,000.00	15,000.00	230,855.84	.....	.....	40,625.25	3,480.90
50	Utah.....	15,000.00	15,000.00	17,881.13	.....	.....	7,986.11	1,324.07
51	Vermont.....	15,000.00	15,000.00	6,735.82	.....	.....	.....	.....
52	Virginia.....	15,000.00	15,000.00	27,229.16	.....	.....	7,914.84	7,771.48
53	Virginia (Truck) ...	.....	.....	.....	.....	.....	.....	.....
54	Washington.....	15,000.00	15,000.00	58,176.22	.....	.....	19,284.58	2,357.64
55	West Virginia.....	15,000.00	15,000.00	45,000.00	.....	.....	15,030.38	.....
56	Wisconsin.....	15,000.00	15,000.00	95,000.00	.....	.....	.....	.....
57	Wyoming.....	15,000.00	15,000.00	.....	.....	.....	1,004.57	983.33
	Total.....	720,000.00	720,000.00	2,716,205.36	17,815.40	216,686.47	918,466.34	751,508.08

[1] Including all balances except from Federal funds.
[2] Including Federal appropriations: Alaska, $60,000; Guam, $15,000; Hawaii, $40,000; Porto Rico, $40,000.
[3] For unexpended balances in 1917–18, see tables immediately following.

to equipment, 1917–18.

Total.[2]	Additions to equipment.							
	Buildings.	Library.	Apparatus.	Farm implements.	Live stock.	Miscellaneous.	Total.	
$61,627.30	$13.00	$393.07	$1,149.78	$242.86	$18.62	$1,817.33	$3,634.66	1
[2] 60,000.00	.....	.....	.....	.....	.....	.....	.....	2
92,525.78	5,179.60	159.88	936.53	4,508.65	675.00	101.54	11,561.20	3
87,742.54	1,000.00	325.00	550.00	350.00	2,800.00	300.00	5,325.00	4
213,297.89	.....	.....	.....	.....	.....	30,824.48	30,824.48	5
108,486.84	10,983.26	812.93	2,609.03	1,246.88	7,313.81	1,105.91	24,071.82	6
69,385.34	2,633.93	308.62	323.69	327.58	2.50	520.35	4,116.67	7
31,023.08	109.48	12.76	24.65	352.69	.....	.....	499.58	8
63,773.30	.....	105.81	1,983.77	.....	.....	2,238.38	4,327.96	9
50,643.69	.....	394.57	376.10	148.91	1,100.00	186.65	2,206.23	10
37,118.25	.....	15.00	5.35	67.19	.....	.....	87.54	11
[1] 15,000.00	.....	.....	.....	.....	.....	.....	.....	12
44,571.11	.....	21.69	11.65	467.23	28.50	174.37	703.44	13
34,038.13	2,000.00	50.00	1,000.00	500.00	2,000.00	500.00	6,050.00	14
316,349.98	7,137.08	.....	.....	.....	8,071.17	12,524.39	27,732.64	15
408,770.04	15,000.00	1,408.94	3,100.97	2,663.45	1,500.00	3,997.57	27,670.93	16
218,743.55	486.09	41.65	182.58	483.03	151.25	.....	1,344.60	17
168,139.62	15,000.00	500.00	1,000.00	14,000.00	1,800.00	2,600.00	34,900.00	18
247,768.58	230.00	500.00	300.00	100.00	1,780.00	500.00	3,410.00	19
67,946.16	.....	150.00	.....	550.00	.....	.....	700.00	20
74,529.14	7,000.00	210.00	220.00	1,050.00	650.00	.....	9,130.00	21
108,248.76	.....	580.88	1,184.65	1,351.87	566.71	809.17	4,493.28	22
122,690.84	1,636.85	416.44	241.38	355.04	191.72	.....	2,841.43	23
89,578.29	4,520.95	274.47	905.40	1,312.36	1,288.36	.....	8,301.54	24
303,078.30	9,188.96	1,172.56	858.53	8,633.63	5,448.38	3,125.38	28,427.44	25
86,509.38	16,450.00	30.00	72.76	1,784.00	22,247.89	792.76	41,377.41	26
137,950.86	1,807.77	31.00	830.26	1,157.44	5,531.97	1,832.66	11,191.10	27
143,922.27	25,000.00	457.00	1,994.00	3,115.00	5,057.00	3,183.00	38,806.00	28
272,543.64	65,000.00	1,050.00	2,036.24	1,500.00	25,000.00	46,000.00	140,586.24	29
33,640.93	769.59	81.95	202.22	202.49	1,862.43	596.63	3,715.31	30
41,048.73	.....	.....	138.75	74.24	2.00	.....	214.99	31
160,977.47	.....	.....	.....	.....	.....	.....	.....	32
30,000.00	1,022.00	94.00	704.00	3,205.00	950.00	1,277.00	7,250.00	33
56,763.70	2,557.03	54.54	481.05	1,471.12	579.68	630.08	5,773.50	34
142,269.28	100,000.00	.....	.....	.....	.....	5,870.21	105,870.21	35
27,000.00	665.81	19.01	239.86	897.93	.....	13.49	1,836.10	36
146,943.03	1,500.00	240.00	150.00	475.00	.....	375.00	2,740.00	37
123,714.78	400.00	62.63	804.30	1,007.30	5,390.18	271.01	7,935.42	38
414,236.89	805.00	658.00	5,644.00	7,705.00	1,598.00	2,901.00	19,311.00	39
43,991.15	877.87	785.23	711.26	1,179.36	1,896.25	33,270.61	38,720.58	40
107,001.67	28,889.31	42.76	578.21	2,150.44	8,333.27	421.32	40,415.31	41
72,615.17	.....	200.00	300.00	1,640.00	5,602.00	.....	7,742.20	42
.....	2,214.44	70.00	400.00	.....	250.00	.....	2,934.44	43
[4] 40,000.00	376.44	182.96	53.25	2,120.21	.....	508.16	3,241.02	44
37,815.94	215.00	208.00	467.00	18.00	40.00	554.00	1,502.00	45
45,722.13	.....	120.17	369.95	2,724.96	6,125.00	.....	9,340.08	46
62,396.12	1,700.00	89.00	140.00	1,200.00	1,340.00	.....	4,469.00	47
64,900.08	9,019.30	780.00	356.06	6,570.21	2,000.00	841.55	19,567.12	48
304,961.99	42,488.32	911.08	2,645.72	9,321.49	16,447.79	10,149.25	81,963.65	49
57,191.31	1,418.61	596.76	1,142.73	658.54	108.73	.....	3,925.37	50
36,735.82	1,205.45	44.51	750.08	65.00	546.74	.....	2,611.78	51
72,915.48	777.96	174.02	149.15	1,011.97	1,176.50	.....	3,289.60	62
.....	2,427.09	124.20	22.75	616.95	275.00	209.09	3,674.99	53
109,818.44	8,946.11	287.54	1,482.15	2,876.53	300.00	1,210.59	15,102.92	54
90,030.38	1,600.00	750.00	2,500.00	500.00	1,800.00	200.00	7,350.00	55
125,000.00	13,800.94	422.46	1,452.22	2,310.04	2,463.83	2,413.31	22,862.80	56
31,987.90	3,000.00	940.00	950.00	1,200.00	1,000.00	1,600.00	8,690.00	57
6,215,681.65	417,053.24	17,361.09	44,732.03	97,649.59	153,310.28	176,446.15	906,472.64	

[1] Territorial.
[5] Including balances from previous year: Minnesota, $82.22; New York (State), $21.23 Hatch, $0.16 Adams.

Expenditures from United States appropriations received under the act of Mar. 2, 1887 (Hatch Act), for the year ended June 30, 1918.

Station.	Amount of appropriation.	Classified expenditures.								
		Salaries.	Labor.	Publications.	Postage and stationery.	Freight and express.	Heat, light, and water.	Chemical supplies.	Seeds, plants, and sundry supplies.	Fertilizers.
Alabama	$15,000.00	$7,386.72	$1,977.85	$2,181.46	$338.58	$222.68	$433.24	$9.93	$785.78	$591.78
Arizona	15,000.00	11,192.81	133.17	1,051.51	765.51	71.47	1,073.17	.....	96.41	.....
Arkansas	15,000.00	8,347.13	1,501.89	2,315.69	293.88	257.03	80.38	173.42	579.77	114.30
California	15,000.00	13,859.76	840.00	300.24	.....	.....	.....	.....	.....	.....
Colorado	15,000.00	9,756.94	1,109.12	1,512.93	105.05	18.94	.....	.....	193.25	.....
Connecticut (State)	7,500.00	7,500.00	.....	.....	.....	.....	.....	.....	.....	.....
Connecticut (Storrs)	7,500.00	6,867.34	243.56	35.82	38.41	.....	.93	34.41	158.67	23.00
Delaware	15,000.00	8,858.76	2,421.28	842.35	506.07	92.81	140.78	263.64	250.85	80.22
Florida	15,000.00	7,689.13	3,506.37	1,187.40	668.82	156.66	163.90	6.93	175.26	89.17
Georgia	15,000.00	6,848.27	2,045.19	.....	239.44	3.41	391.06	.....	136.11	194.04
Idaho	15,000.00	8,879.86	2,493.76	1,058.58	318.20	154.98	33.00	152.22	386.56	3.65
Illinois	15,000.00	11,856.76	1,054.77	1,911.22	51.46	1.34	.....	.....	9.45	.....
Indiana	15,000.00	10,317.70	989.16	722.58	131.82	.....	.....	204.23	239.69	9.50
Iowa	15,000.00	7,927.50	1,361.62	1,374.59	337.77	34.47	80.15	60.63	581.40	86.58
Kansas	15,000.00	8,827.49	4,665.63	16.07	82.33	4.57	.....	403.89	250.71	21.40
Kentucky	15,000.00	11,090.19	503.78	888.05	427.72	87.68	682.14	347.98	194.27	.....
Louisiana	15,000.00	5,133.25	3,289.91	468.39	97.69	.....	.....	.....	677.69	643.18
Maine	15,000.00	5,813.54	2,696.58	175.83	982.19	162.81	585.82	.....	448.73	639.65
Maryland	15,000.00	11,074.14	2,421.48	787.82	9.55	14.00	6.00	118.78	15.34	.....
Massachusetts	15,000.00	14,529.96	358.52	.....	.....	.....	.....	.....	33.23	78.29
Michigan	15,000.00	8,076.80	2,240.34	300.11	44.60	6.91	128.42	719.96	969.91	315.62
Minnesota	[1] 15,000.00	15,000.00	.....	.....	.....	.....	.....	.....	.....	.....
Mississippi	15,000.00	8,632.24	2,392.43	682.02	115.17	57.41	228.19	.....	408.00	.....
Missouri	15,000.00	11,083.55	1,190.66	4.00	132.12	13.31	32.70	122.26	117.32	.....
Montana	15,000.00	10,555.35	1,416.30	746.10	362.10	155.22	64.61	76.29	304.46	.....
Nebraska	15,000.00	6,345.00	3,410.72	2,869.51	213.75	.....	.....	213.41	336.51	.....
Nevada	15,000.00	8,892.64	1,869.10	568.89	401.24	155.40	158.40	368.47	309.81	.....
New Hampshire	15,000.00	9,318.65	956.53	2,019.02	884.60	280.57	600.00	14.56	207.50	21.00
New Jersey	15,000.00	8,777.01	972.00	480.82	604.92	18.28	574.70	258.80	347.42	210.46
New Mexico	15,000.00	5,217.44	3,304.50	1,340.52	262.99	407.62	81.96	164.74	317.53	168.96
New York (State)	[1] 1,500.00	1,049.88	314.92	.....	.....	.....	.....	.....	43.39	44.00
New York (Cornell)	13,500.00	7,017.14	3,208.80	237.00	166.93	67.92	21.60	128.22	336.85	62.65
North Carolina	15,000.00	7,176.63	2,913.04	81.18	230.56	17.28	183.25	191.06	302.52	602.66
North Dakota	15,000.00	13,205.26	1,139.91	.....	.....	.....	.....	.....	.....	.....
Ohio	15,000.00	1,890.24	1,954.23	135.69	205.32	691.47	894.58	787.15	633.29	.....
Oklahoma	15,000.00	8,674.01	2,711.68	167.40	385.65	5.92	116.76	55.00	617.85	9.00
Oregon	15,000.00	11,182.97	840.32	458.89	84.31	40.82	7.17	28.70	249.74	3.12
Pennsylvania	15,000.00	9,030.40	951.22	3,164.80	226.20	45.07	.....	49.95	152.29	590.89

Rhode Island	15,000.00	5,445.39	4,225.53	743.06	268.82	159.96	390.97	36.32	792.67	1,170.42
South Carolina	15,000.00	8,556.25	2,639.53	524.69	491.51	47.75	166.46	.....	247.52	784.30
South Dakota	15,000.00	7,785.84	2,494.56	2,095.29	202.31	44.26	33.55	85.24	331.28	21.62
Tennessee	15,000.00	10,568.35	1,467.95	351.65	263.04	134.38	616.08	17.06	516.66	4.00
Texas	15,000.00	8,222.83	1,238.37	1,946.53	341.47	200.22	113.93	62.20	154.13	243.00
Utah	15,000.00	7,203.37	1,729.82	331.34	571.38	.....	88.02	119.87	279.28	.....
Vermont	15,000.00	8,925.72	1,311.60	31.00	339.15	123.43	1,286.55	246.61	503.62	2.50
Virginia	15,000.00	8,396.41	2,515.90	1,055.85	567.23	169.46	149.71	42.71	615.51	578.95
Washington	15,000.00	8,648.17	2,755.47	617.54	451.14	146.89	32.56	25.00	797.58	74.86
West Virginia	15,000.00	11,450.21	1,593.39	.....	11.75	134.57	.....	50.16	196.44	478.55
Wisconsin	15,000.00	10,448.52	327.29	21.05	55.54	16.74	31.55	925.00	921.59	193.98
Wyoming	15,000.00	8,425.17	2,545.16	805.70	359.14	17.87	135.18	64.16	286.35	.....
Total	720,000.00	438,958.69	90,244.91	38,610.18	13,637.43	4,441.58	9,807.47	6,628.96	16,510.19	8,155.30

Station.	Classified expenditures—Continued.									
	Feeding stuffs.	Library.	Tools, implements, machinery.	Furniture and fixtures.	Scientific apparatus.	Live stock.	Traveling expenses.	Contingent expenses.	Buildings and repairs.	Balances.
Alabama	$89.70	$255.45	$319.12	$54.50	$4.87	$18.62	$98.43	$20.00	$211.29	.....
Arizona	.....	138.70	12.25	23.99	.....	.....	441.01	.....	.....	.....
Arkansas	145.15	2.70	148.62	54.21	41.80	115.86	509.35	20.00	298.82	.....
California	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Colorado	98.16	393.06	31.45	161.29	183.40	312.10	527.09	20.00	577.22	.....
Connecticut (State)	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Connecticut (Storrs)	14.54	20.02	57.80	.....	5.50	.....	.....	.....	.....	.....
Delaware	65.00	104.56	4.14	899.51	172.07	.....	272.96	25.00	.....	.....
Florida	609.26	358.49	168.96	165.90	.....	.....	.....	20.00	33.75	.....
Georgia	276.55	6.00	67.19	26.83	.....	.....	180.22	13.60	183.97	$4,388.12
Idaho	874.30	38.47	209.79	102.91	199.30	.....	61.85	20.00	12.57	.....
Illinois	.....	.....	.....	.....	95.00	.....	.....	20.00	.....	.....
Indiana	2,176.23	8.10	30.00	.....	13.00	48.00	93.99	.....	16.00	.....
Iowa	2,456.30	.....	206.56	56.91	14.50	151.25	116.56	20.00	133.21	.....
Kansas	.....	.....	599.08	6.76	.....	.....	90.13	31.50	1.45	.....
Kentucky	.....	200.46	12.97	149.40	45.00	.....	321.64	20.00	28.72	.....
Louisiana	1,761.68	.....	1,349.02	2.35	.....	1,381.95	4.80	20.00	170.09	.....
Maine	1,477.33	208.18	353.43	135.83	6.20	37.50	488.08	40.00	748.30	.....
Maryland	412.62	16.52	21.48	76.50	12.12	.....	.....	.....	13.65	.....
Massachusetts	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Michigan	.....	196.39	471.09	138.19	179.35	.....	1,192.31	20.00	.....	.....
Minnesota	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Mississippi	1,084.45	.....	1,222.18	.....	.....	50.00	.....	.....	127.91	.....
Missouri	1,073.12	.....	52.32	203.65	.....	411.11	105.06	.....	458.82	.....

[1] Including balances as follows: Minnesota, $82.22; New York (State), $21.23.

Expenditures from United States appropriations received under the act of Mar. 2, 1887 (Hatch Act), for the year ended June 30, 1918—Continued.

Station.	Classified expenditures—Continued.									
	Feeding stuffs.	Library.	Tools, implements, machinery.	Furniture and fixtures.	Scientific apparatus.	Live stock.	Traveling expenses.	Contingent expenses.	Buildings and repairs.	Balances.
Montana	$461.25	$51.44	$128.15	$143.60	$154.38	$125.00	$207.45	.....	$48.30	.....
Nebraska	1,308.10	3.20	194.00	105.80	.....	.....	.....	.....	.....	.....
Nevada	177.82	65.70	243.74	575.98	2.38	30.00	697.28	$25.00	458.15	.....
New Hampshire	216.55	181.28	116.33	.....	2.20	2.00	158.21	21.00	.....	.....
New Jersey	.....	11.19	222.76	267.29	13.76	150.00	1,509.28	.....	581.31	.....
New Mexico	1,487.50	12.75	651.38	371.89	12.30	475.43	284.31	20.00	418.18	.....
New York (State)	.....	.....	.....	.....	.....	.....	.....	.....	.....	$47.81
New York (Cornell)	.....	19.07	669.33	13.49	29.25	.....	915.04	.....	606.71	.....
North Carolina	1,771.42	.....	738.87	.....	61.50	.....	276.29	20.00	433.74	.....
North Dakota	.....	.....	361.10	17.65	.....	.....	.....	.....	.....	276.08
Ohio	4,218.37	7.80	2,138.23	.....	698.61	.....	52.80	20.00	672.22	.....
Oklahoma	441.80	161.64	694.47	188.28	152.40	38.75	166.89	.....	412.50	.....
Oregon	1,150.34	.93	182.91	13.28	27.15	88.50	616.30	24.55	.....	.....
Pennsylvania	5.87	87.87	10.89	199.25	.....	.....	348.10	.....	137.20	.....
Rhode Island	814.28	199.68	248.56	8.35	14.40	10.00	32.24	20.00	419.35	.....
South Carolina	937.71	40.00	407.69	19.81	.....	.....	92.54	20.00	24.24	.....
South Dakota	779.00	25.62	252.45	246.45	.....	.....	257.54	20.00	324.99	.....
Tennessee	187.03	193.25	308.50	36.10	168.03	.....	19.35	20.00	128.57	.....
Texas	422.15	369.98	284.61	354.33	92.41	80.00	438.17	20.00	415.67	.....
Utah	1,751.53	253.70	303.91	477.43	99.72	5.05	1,031.35	7.50	746.73	.....
Vermont	314.83	38.50	206.84	251.97	334.50	.....	313.18	20.00	750.00	.....
Virginia	61.42	172.52	126.86	89.11	26.20	8.50	252.08	40.00	131.58	.....
Washington	35.75	11.65	141.82	378.74	189.36	.....	673.47	20.00	.....	.....
West Virginia	75.73	.....	19.80	.....	.....	.....	989.40	.....	.....	.....
Wisconsin	150.13	.....	106.30	1.75	1,032.60	3.50	764.46	.....	.....	.....
Wyoming	1,386.56	84.76	353.41	5.50	6.11	.....	31.75	.....	493.18	.....
Total	30,769.53	3,939.63	14,450.36	6,023.77	4,089.37	3,543.12	14,630.96	628.15	10,218.39	4,712.01

Expenditures from United States appropriations received under the act of Mar. 16, 1906 (Adams Act), for the year ended June 30, 1918.

Station.	Amount of appropriation.	Classified expenditures.							
		Salaries.	Labor.	Postage and stationery.	Freight and express.	Heat, light, and water.	Chemical supplies.	Seeds, plants, and sundry supplies.	Fertilizers.
Alabama	$15,000.00	$8,742.15	$1,522.02	$125.24	$184.38	$363.74	$1,452.48	$257.19	$50.00
Arizona	15,000.00	11,940.59	749.39	79.80	333.85	.....	125.62	146.89	.....
Arkansas	15,000.00	9,398.22	1,588.18	263.18	148.12	215.47	880.41	771.01	118.00
California	15,000.00	10,390.96	1,481.03	5.03	18.80	11.25	439.14	273.96	6.95
Colorado	15,000.00	12,884.12	483.15	181.18	26.52	2.40	144.40	160.15	.....
Connecticut (State)	7,500.00	4,974.05	387.16	92.58	99.37	644.57	284.15	208.14	43.75
Connecticut (Storrs)	7,500.00	5,714.07	889.19	1.16	13.52	1.65	73.21	45.25	.....
Delaware	15,000.00	11,453.99	35.63	.....	64.16	.....	912.48	118.60	38.40
Florida	15,000.00	11,443.96	950.87	53.78	115.01	233.57	323.61	275.72	124.75
Georgia	15,000.00	5,338.29	101.65	.....	5.67	142.10	34.29	23.00	.....
Idaho	15,000.00	7,982.74	2,184.70	39.37	251.85	33.00	442.36	603.21	212.75
Illinois	15,000.00	11,016.02	2,242.27	40.02	9.35	.....	447.34	.....	.....
Indiana	15,000.00	12,912.80	445.75	37.15	.....	.....	91.21	114.95	.....
Iowa	15,000.00	7,793.67	1,948.28	183.55	147.38	79.63	1,595.75	772.84	98.75
Kansas	15,000.00	7,683.27	2,238.12	19.11	23.10	38.82	623.09	657.06	1.60
Kentucky	15,000.00	11,683.91	430.45	3.56	13.36	249.40	552.62	169.25	.....
Louisiana	15,000.00	10,884.25	444.20	201.91	43.33	266.48	1,107.33	256.04	.....
Maine	15,000.00	9,256.98	1,290.52	49.61	99.17	243.52	17.50	355.00	.....
Maryland	15,000.00	11,481.52	711.07	6.72	.....	.....	1,071.42	214.30	.....
Massachusetts	15,000.00	14,913.95	10.00	.....	.....	.....	42.05	34.00	.....
Michigan	15,000.00	10,395.65	2,188.66	2.58	.....	.....	518.12	228.96	.....
Minnesota	15,000.00	15,000.00	.....	.....	.....	.....	.....	.....	.....
Mississippi	15,000.00	7,330.98	7,301.46	27.58	18.50	5.57	130.12	27.35	.....
Missouri	15,000.00	5,932.52	3,070.35	19.64	93.39	13.31	520.33	486.78	68.33
Montana	15,000.00	11,833.35	984.57	54.65	43.66	43.85	624.79	216.11	.....
Nebraska	15,000.00	11,615.87	1,460.64	.....	37.12	.....	298.28	228.09	.....
Nevada	15,000.00	9,789.13	734.95	24.63	72.77	23.10	372.67	261.27	.....
New Hampshire	15,000.00	10,097.35	2,643.27	13.50	1.50	.....	148.92	375.26	308.79
New Jersey	15,000.00	12,386.50	827.11	10.41	2.79	285.42	417.99	95.60	.....
New Mexico	15,000.00	7,977.56	2,327.80	73.09	179.31	512.05	1,204.99	450.75	19.16
New York (State)	[1]1,500.00	1,149.88	.....	.....	.....	.....	.....	.....	.....
New York (Cornell)	13,500.00	10,708.15	1,334.96	57.01	4.57	.....	501.73	244.50	143.75
North Carolina	15,000.00	12,579.04	1,030.55	119.72	39.70	161.50	170.42	254.85	376.98
North Dakota	15,000.00	10,591.51	381.10	21.28	.....	.....	883.64	134.93	.....
Ohio	15,000.00	10,197.49	696.74	5.63	.....	.....	2,217.68	3.18	.....
Oklahoma	15,000.00	5,570.01	3,012.21	31.08	6.87	36.06	289.41	772.20	35.00

[1] Including balance, $0.16.

Expenditures from United States appropriations received under the act of Mar. 16, 1906 (Adams Act), for the year ended June 30, 1918—Continued

Station.	Amount of appropriation.	Classified expenditures.							
		Salaries.	Labor.	Postage and stationery.	Freight and express.	Heat, light, and water.	Chemical supplies.	Seeds, plants, and sundry supplies.	Fertilizers.
Oregon	$15,000.00	$10,875.09	$1,078.66	$33.98	$117.36	$67.68	$1,451.36	$759.55	.....
Pennsylvania	15,000.00	12,488.16	382.84	.30	309.68	52.54	340.26	38.62	$874.02
Rhode Island	15,000.00	7,714.10	3,263.85	62.83	40.67	412.91	485.67	180.22	.....
South Carolina	15,000.00	10,319.99	2,012.11	60.85	51.49	164.42	646.52	382.54	237.38
South Dakota	15,000.00	8,565.77	3,394.68	54.50	129.71	54.77	523.30	443.77	82.94
Tennessee	15,000.00	11,933.35	966.12	53.59	53.21	162.01	518.55	151.54	6.50
Texas	15,000.00	9,165.64	1,413.55	121.18	397.65	469.12	959.65	257.01	4.80
Utah	15,000.00	9,239.30	3,556.33	30.75	1.03	259.76	543.32	228.26	.....
Vermont	15,000.00	7,964.14	3,170.55	52.69	20.12	66.78	387.16	254.03	34.50
Virginia	15,000.00	9,073.01	2,371.76	.....	101.01	1.35	363.24	423.90	281.38
Washington	15,000.00	9,772.06	2,154.33	25.23	53.89	11.00	665.55	33.82	24.05
West Virginia	15,000.00	10,993.99	1,424.66	45.06	.....	.....	120.77	407.53	181.79
Wisconsin	15,000.00	8,850.00	2,438.15	24.84	20.87	4.85	238.54	257.04	.....
Wyoming	15,000.00	9,605.99	1,100.28	8.82	201.75	239.33	896.47	88.52	.....
Total	720,000.00	487,605.09	76,855.87	2,418.37	3,595.56	5,572.98	27,099.91	13,142.74	3,404.32

Station.	Classified expenditures—Continued.								
	Feeding stuffs.	Library.	Tools, implements, and machinery.	Furniture and fixtures.	Scientific apparatus.	Live stock.	Traveling expenses.	Contingent expenses.	Buildings and repairs.	Balances.
Alabama	$532.40	$135.62	$27.99	$207.84	$641.20	.....	$644.57	.....	$113.18	.....
Arizona	40.92	10.23	73.46	.....	882.53	.....	607.72	.....	9.00	.....
Arkansas	475.98	.....	125.83	45.08	313.14	$83.55	537.73	.....	36.10	.....
California	255.36	18.26	76.08	135.64	216.31	530.85	1,118.02	.....	22.36	.....
Colorado	.....	20.50	71.55	6.55	462.19	.....	445.09	.....	112.20	.....
Connecticut (State)	423.09	.....	66.33	99.13	69.44	2.50	92.74	$13.00	.....	.....
Connecticut (Storrs)	481.33	.....	2.06	.....	9.71	188.62	80.23	.....	.....	.....
Delaware	.....	1.25	.....	162.75	1,811.70	.....	258.04	3.00	140.00	.....
Florida	.....	36.08	74.88	20.75	376.10	.....	915.62	.....	55.30	.....

Georgia	72.85	9.00			5.35					$9,267.80
Idaho	234.20	3.10	1,139.45	61.00	918.83		868.84		24.60	
Illinois	1,159.85		41.45			43.70				
Indiana		3.95			215.92	1,122.15	56.12			
Iowa	1,204.37	41.65	276.47	37.50	168.08		299.20		352.88	
Kansas	3,189.37		10.46	6.45	172.13	10.70	135.91		190.81	
Kentucky	727.50	103.90	25.65	20.40	147.50	795.30	52.72	1.50	22.98	
Louisiana	352.00	81.31	99.00	344.50	413.87	135.00	279.08		91.70	
Maine	3,122.81		33.00				344.29	40.00	147.60	
Maryland			63.27	620.10	415.09		24.44	21.23	370.84	
Massachusetts										
Michigan	594.98	8.42	35.02	.48	380.32	411.93	38.62		196.26	
Minnesota										
Mississippi	53.00						105.44			
Missouri	3,368.12		416.01	138.50	392.09	125.00	206.60	3.50	145.53	
Montana		18.07	162.47	383.01	238.89		350.68		45.90	
Nebraska	670.26		30.84		569.76		69.14		20.00	
Nevada	1,248.04	5.75	258.22	20.65	46.67	1,562.46	306.65		273.04	
New Hampshire	611.76	1.26	44.45		136.55		148.53		468.86	
New Jersey	360.00		84.71	22.25	66.01				441.21	
New Mexico	839.01	6.74	402.32	61.57	468.75	50.00	2.70		424.20	
New York (State)					105.00					245.12
New York (Cornell)			228.60		210.61		7.02		59.10	
North Carolina			105.44		93.18		68.62			
North Dakota	1,550.37	6.51	10.10		153.17	830.08	76.16			361.15
Ohio				83.03	1,794.75	1.50				
Oklahoma	1,367.57	114.73	392.76	443.44	558.86	1,849.00	73.43		447.37	
Oregon	63.35	4.63	103.74	30.00	400.25		14.35			
Pennsylvania		5.25	42.15		241.45		211.34		13.39	
Rhode Island	2,323.15	8.45	210.78	4.98	122.85	113.99	9.02		46.53	
South Carolina		40.17	487.67	3.50	369.95		171.90		21.51	
South Dakota	375.65	6.00	203.11	91.97	148.03		204.88		720.92	
Tennessee	21.25	68.50	165.68	257.68	188.03		145.78		308.21	
Texas	256.54	31.10	299.46	493.83	414.01	319.10	36.20		361.16	
Utah	363.52		39.50		371.79	88.43	197.44		80.57	
Vermont	1,389.35	6.01	7.77	12.10	415.58	546.74	217.03		455.45	
Virginia	1,425.09		91.56		97.18	54.50	417.65		298.37	
Washington	1,514.65		116.39	45.71	255.81	50.00	277.51			
West Virginia	146.47		231.52	5.75	631.20		729.61		81.65	
Wisconsin	2,779.20		124.54	94.04	130.70		37.23			
Wyoming	1,144.22	54.23	246.24	102.25	927.95	203.75	137.97		42.23	
Total	34,737.58	850.67	6,747.98	4,062.43	17,168.48	9,118.85	11,021.86	82.23	6,641.01	9,874.07

Disbursements from the United States Treasury to the States and Territories for agricultural experiment stations under the acts of Congress approved Mar. 2, 1887, and Mar. 16, 1906.

State or Territory.	Hatch Act.		Adams Act.	
	1888–1917	1918	1906–1917	1918
Alabama	$448,956.42	$15,000.00	$146,619.89	$15,000.00
Arizona	414,803.10	15,000.00	149,995.61	15,000.00
Arkansas	448,139.12	15,000.00	149,900.00	15,000.00
California	450,000.00	15,000.00	149,926.84	15,000.00
Colorado	449,718.82	15,000.00	148,638.93	15,000.00
Connecticut	450,000.00	15,000.00	150,000.00	15,000.00
Dakota Territory	56,250.00			
Delaware	448,382.87	15,000.00	145,475.12	15,000.00
Florida	449,966.06	15,000.00	149,996.06	15,000.00
Georgia	449,981.55	15,000.00	146,360.67	15,000.00
Idaho	374,824.13	15,000.00	145,842.22	15,000.00
Illinois	449,564.95	15,000.00	149,851.62	15,000.00
Indiana	449,901.19	15,000.00	150,000.00	15,000.00
Iowa	450,000.00	15,000.00	150,000.00	15,000.00
Kansas	449,995.00	15,000.00	150,000.00	15,000.00
Kentucky	449,996.57	15,000.00	150,000.00	15,000.00
Louisiana	450,000.00	15,000.00	150,000.00	15,000.00
Maine	449,999.62	15,000.00	150,000.00	15,000.00
Maryland	449,967.40	15,000.00	149,236.48	15,000.00
Massachusetts	449,617.70	15,000.00	150,000.00	15,000.00
Michigan	449,676.10	15,000.00	146,341.20	15,000.00
Minnesota	450,000.00	14,917.78	149,345.00	15,000.00
Mississippi	450,000.00	15,000.00	150,000.00	15,000.00
Missouri	445,097.24	15,000.00	149,999.90	15,000.00
Montana	360,000.00	15,000.00	147,417.04	15,000.00
Nebraska	449,932.16	15,000.00	150,000.00	15,000.00
Nevada	449,214.32	15,000.00	148,180.28	15,000.00
New Hampshire	450,000.00	15,000.00	150,000.00	15,000.00
New Jersey	449,949.97	15,000.00	149,558.78	15,000.00
New Mexico	414,509.05	15,000.00	150,000.00	15,000.00
New York	449,846.79	14,978.77	149,745.81	14,999.84
North Carolina	450,000.00	15,000.00	150,000.00	15,000.00
North Dakota	391,778.34	15,000.00	150,000.00	15,000.00
Ohio	450,000.00	15,000.00	148,514.02	15,000.00
Oklahoma	374,568.96	15,000.00	131,360.56	15,000.00
Oregon	435,156.64	15,000.00	145,000.00	15,000.00
Pennsylvania	449,967.43	15,000.00	149,995.41	15,000.00
Rhode Island	450,000.00	15,000.00	147,464.20	15,000.00
South Carolina	449,542.15	15,000.00	148,460.12	15,000.00
South Dakota	393,250.00	15,000.00	145,000.00	15,000.00
Tennessee	450,000.00	15,000.00	150,000.00	15,000.00
Texas	450,000.00	15,000.00	147,592.26	15,000.00
Utah	315,000.00	15,000.00	149,821.94	15,000.00
Vermont	450,000.00	15,000.00	150,000.00	15,000.00
Virginia	447,824.12	15,000.00	149,949.01	15,000.00
Washington	387,102.65	15,000.00	146,080.11	15,000.00
West Virginia	449,968.71	15,000.00	147,859.12	15,000.00
Wisconsin	450,000.00	15,000.00	150,000.00	15,000.00
Wyoming	435,000.00	15,000.00	150,000.00	15,000.00
Total	10,987,444.13	719,896.54	7,124,528.40	719,999.84